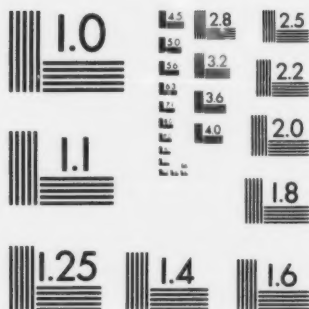
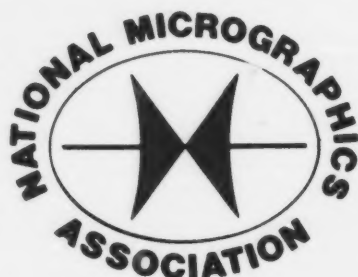


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FORAGE INVENTORY
OF THE
RAM-CLEARWATER STUDY AREA

by
J.H. Archibald

ENR No. T/19-No.5

FORAGE INVENTORY
OF THE
RAM-CLEARWATER STUDY AREA

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Edmonton
1982

Alberta
ENERGY AND NATURAL RESOURCES
Resource Evaluation and Planning Division

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Other titles in this series include:

- T/19 - No. 1 Forage Inventory of the Jean D'Or Prairie Study Area
- T/19 - No. 2 Forage Inventory of the Brazeau-Pembina Study Area
- T/19 - No. 3 Forage Inventory of the Rocky-North Saskatchewan Study Area
- T/19 - No. 4 Forage Inventory of the Chungo-Cline-Nordegg Study Area

ABSTRACT

An inventory of forage was undertaken in the Ram-Clearwater Study Area in the summer of 1981. The purpose of the inventory is to provide basic data on the forage resource. The objectives are to classify and describe the vegetation, to determine the annual yield of herbaceous forage and palatable browse, and to prepare a map at a 1:50 000 scale.

Species composition and biomass are tabulated for 16 forage types which occur in the Ram-Clearwater study area. The native forage consists of a variety of shrubs, forbs, and grasses. Variation in biomass is evident among and within forage types.

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1. INTRODUCTION

Alberta Energy and Natural Resources is responsible for the orderly development and wise use of our renewable resources. To ensure this, the department has adopted a policy of integrated resource management. Fundamental to this is the preparation of an integrated resource management plan that gives full consideration to all possible uses of the land. In order that the plan be based upon sound knowledge, inventories of all aspects of the resources of the area are conducted. The forage inventory is one of a number of resource inventories carried out.

In order to manage resources in a manner that ensures sustained forage yield and compatibility with other land uses, a good knowledge of the quality and extent of the grazing resource is required. The forage inventory provides this information at a reconnaissance level. The study provides information on potential areas for grazing by domestic cattle and ungulates. As well, the study identifies high-priority areas where more intensive surveys should be initiated.

Ram-Clearwater is one area for which an integrated resource management plan is to be prepared. As part of this plan, an inventory of forage was conducted during the summer of 1981. The objectives of this inventory were to identify and describe major forage types and to determine the yield of herbaceous forage. The provision of base-line data will allow the various management agencies to interpret the information which, when combined with other resource utilization input, can lead to the formulation of sound land-use decisions.

2. STUDY AREA

2.1 Location and Extent

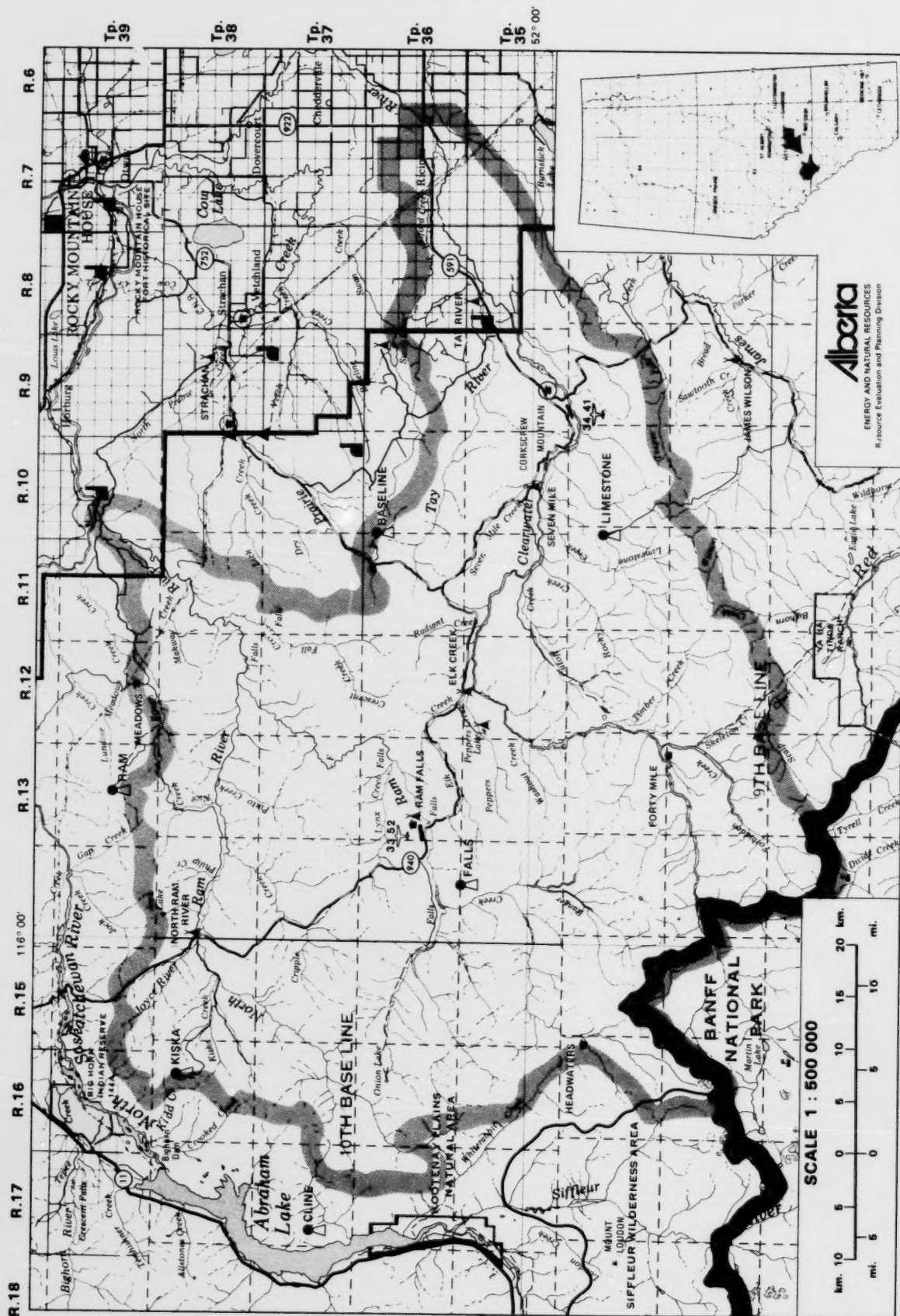
The Ram-Clearwater study area covers approximately 3 640 km² (1 400 mi.²) in west-central Alberta (Figure 1). The area lies between 115° 00' and 116° 20' west longitude and between 51° 45' and 52° 20' north latitude, and includes all or parts of Townships 32 to 39, Ranges 8 to 17, West of the Fifth Meridian. It includes Forest Management Units R8 and R9.

2.2 Physiographic Regions

Physiographic regions within the Ram-Clearwater study area are well defined, based on major differences in relief, elevation, bedrock, and surface expression. The area is divided into three regions: Rocky Mountain Region, Foothills Region, and Benchlands Region.

2.2.1 Rocky Mountain Region

The Rocky Mountain Region occurs in the western portion of the study area. It is a region of high relief (800 - 1 000 m) with elevation ranging from approximately 1 200 m to 2 400 m above sea level. The bedrock consists of Paleozoic to Mesozoic carbonate rocks, shales, and sandstones. The region consists of sharp-ridged mountain massif and rounded ridges of intervening eroded lowlands. Parent materials are dominantly rock, with colluvial, morainal, saprolitic, and fluvial materials occurring to a lesser extent.



2.2.2 Foothills Region

The Foothills Region is an area of lower relief (300-900 m) which occurs east of the Rocky Mountain Region. Elevations range from 1 000 m to 1 999 m above sea level (a.s.l.). The area consists of northwest- to southeast-trending overthrust ridges with shallow southwest-facing dip slopes and steeper northeast-facing scarp slopes. The dominant bedrock is late Mesozoic shales and sandstones. Colluvium is the most dominant parent material on slopes, with morainal veneers common on lower slopes and saprolitic material being quite rare. The valleys are dominated by glaciofluvial, glaciolacustrine, fluvial (floodplains, fans, and aprons), and hummocky moraine deposits.

2.2.3 Benchlands Region

The Benchlands Region lies east of the foothills. Elevations range from 1 140 to 1 290 m a.s.l. and relief is considerably lower than the other ranges. Tertiary and cretaceous non-marine sandstones and shales form the underlying bedrock. Parent materials are variable within this region, with glaciofluvial, fluvial (terraces and floodplains), morainal, organic, eolian, and glaciolacustrine deposits all occurring in localized areas.

2.3 Ecological Regions

The term ecoregion can be defined as "an area characterized by a distinctive regional climate as expressed by vegetation" (Subcommittee on

Biophysical Land Classification, 1969). This definition has been derived from the fact that vegetation responds to different regional climates by altering species composition, physiognomics and successional patterns.

The major climatic regimes -- Prairie, Cordilleran, and Boreal -- are modified by factors such as latitude, elevation, continentality and storm tracks to create 12 ecoregions in Alberta (Strong and Leggat, 1980). These ecoregional climates are represented by both abiotic and biotic factors.

Four ecoregions have been described by Strong and Leggat (1980) in the Ram-Clearwater study area. These are the Boreal Uplands, Subalpine, Alpine, and Boreal Foothills.

2.3.1 Boreal Foothills

The Boreal Foothills Ecoregion (Ecoregion 9, Strong and Leggat) occupies a small area in the southeastern portion of the Ram-Clearwater study area. In general, it occupies plains and uplands topography which is elevated above the Boreal Mixedwood Ecoregion.

The ecoregion is influenced by components of both Boreal and Cordilleran climates. The Boreal influence is expressed by the maximum precipitation being received in summer, while the Cordilleran influence manifests itself as increased winter temperatures and precipitation compared with those of the Boreal Mixedwood.

The mean May-to-September temperature is 11.5°C, with a range

from 10.0 to 12.5° C. The freeze-free period ranges from 50 to 105 days, with the lowest values associated with valley bottoms.

The mean annual precipitation is 570 mm, with a range from 510 to 670 mm. The summer precipitation totals vary from 230-450 mm.

Aspen, balsam poplar, lodgepole pine, and white spruce occur on modal sites in the ecoregion. The deciduous component generally dominates. Secondary succession is to white spruce although black spruce occurs sporadically. Gray Luvisolic soils are dominant on these sites.

Rapidly- and well-drained sites are usually dominated by lodgepole pine. Understory species reflect the dry site conditions. Soils are generally poorly developed.

Imperfectly-drained sites are dominated by lodgepole pine which is succeeded by black or white spruce. Understory vegetation is dominated by mosses and Labrador tea. Common soils are Gleyed Luvisols and Gleysols.

2.3.2 Boreal Uplands

The Boreal Uplands Ecoregion, referred to as Ecoregion 10, occupies the eastern portion of the Ram-Clearwater study area (Strong and Leggat, 1980). Elevationally, it occurs below the Subalpine and above the Boreal Foothills Ecoregion. Both mountain and foothill topography is associated with the area.

The boreal climate of the Uplands is substantially modified by the Rocky Mountains. Cool summer temperatures and ameliorated winter temperatures express this Cordilleran influence. The mean May-to-September temperature is 10.0°C , with a range of 8.5 to 11.5°C . The freeze-free period ranges from 20 to 105 days.

The precipitation regime is continental, as all available stations receive more than 55 percent of their annual precipitation during the May-to-September period. The mean yearly precipitation is 570 mm, with a range of 440 to 740 mm.

Lodgepole pine dominates the overstory vegetation on moderately well-drained substrata in the Boreal Uplands Ecoregion. The cool climate severely restricts the growth of deciduous species such as aspen and balsam poplar. Secondary succession is to white and black spruce. The understory vegetation is relatively non-diverse to the cool mesoclimate and cool microclimate created by the tree canopy.

Imperfectly-drained areas are dominated by lodgepole pine with a successional trend to black spruce. Mosses and ericaceous shrubs are common in the understory.

In areas of poor drainage, black spruce dominates the overstory vegetation. Poor drainage and low oxygen availability result in organic accumulations. These areas commonly have an understory of moss and Labrador tea, indicating acidic conditions and low nutrient availability.

Well- to rapidly-drained sites are characterized by open stands of lodgepole pine dispersed among scattered grasses and shrubs. These sites generally occur on exposed south-facing slopes.

2.3.3 Subalpine

The Subalpine Ecoregion referred to as Ecoregion 6 is an altitudinal vegetation zone with the upper boundary formed by the Alpine Ecoregion and the lower boundary abutting the Montane, Aspen Parkland, and Boreal Uplands Ecoregions.

The Subalpine Ecoregion has a Cordilleran climate characterized by snowy, cold winters and showery, cool summers. The high precipitation, relative to that of the Boreal Uplands Ecoregion, is due to the increased influence of Pacific air masses which are warmer and more moist than Arctic air masses that dominate further to the east during winter.

Mean annual precipitation in the Subalpine Ecoregion is 720 mm, but there is a wide range, from 350 to 1 230 mm. An average of 49 percent of the yearly precipitation occurs during the October-to-April period. Not only are precipitation totals greater, but precipitation events are more frequent.

The mean May-to-September temperature in the Subalpine is 9.5° C. Elevational effects on temperature in this ecoregion are important. During summer, daytime temperatures in Subalpine valleys are warmer than on valley slopes. This trend is often reversed at night, however, as

cold air drains into the valley bottom, making it much cooler than the valley slopes.

Cool conditions are also reflected in the low accumulation of growing degree days, ranging from 710 to 930.

A mean climatic moisture deficit of 110 mm for this ecoregion may be misleading, as temperature data in this ecoregion is limited. Much of this ecoregion actually has a large climatic moisture surplus.

The Subalpine Ecoregion can be divided into three portions: the Pine, Spruce-Fir, and Upper Subalpine Ecoregion.

The Pine Subregion is a zone of lodgepole pine which shows little evidence of succession to Engelmann spruce and/or alpine fir in the first 100 or more years of stand growth. This zone occurs at the lowest elevation of the Subalpine Ecoregion. The Pine Subregion may be too xeric for "typical" spruce-fir succession. It may also be influenced by the lack of spruce seed caused by frequent fires.

The Spruce-Fir Subregion is located altitudinally above the Pine Subregion. Forests of this area differ from the previous subregion by displaying evidence of spruce-fir succession in the early stages of stand development. Moisture is more abundant in this subregion than in the Pine Subregion

The Upper Subalpine Subregion is characterized by open canopied vegetation that occurs between the Spruce-Fir Subregion and the climatic

forest-line of the upper elevational limit of continuous tree growth. Plant growth is retarded in this zone due to the low temperatures, high wind, moisture stress, and the short growing season.

Scattered throughout the Subalpine Ecoregion are grasslands. These grasslands typically occur on steep south-facing slopes where solar insolation and evapotranspiration are very high.

2.3.4 Alpine

The Alpine Ecoregion, referred to as Ecoregion 7, occurs above climatic forest-line in the Rocky Mountains. It is situated above the Subalpine Ecoregion. Forest-line is defined as the zone where contiguous forest stops and isolated islands of trees begin (Strong, 1976). Elevationally, the Alpine occupies terrain above 2 000 m in this portion of the province.

This ecoregion has a more severe Cordilleran climate than the Subalpine. The overriding climatic elements which characterize the Alpine are strong winds, long winters, and cool summers. Below-freezing temperatures are common, even during the warmest months. Precipitation is high during all months, with a tendency for greater precipitation during winter. As there is no overstory vegetation, the surface displays a highly variable microclimate. During summer, the climate of steep south-facing slopes differs markedly from that of the north-facing slopes. During winter, southwest- to northwest-facing slopes may be completely snow-free, whereas east aspects or protected pockets may have snow cover

several metres deep, possibly lasting well into summer or even year-round.

The range in Alpine mean annual precipitation is not as great as that in the Subalpine, but the mean is very similar at 730 mm. The mean May-to-September precipitation is 360 mm, which is 40 mm higher than in the Subalpine Ecoregion. The range in summer Alpine precipitation is 270 to 430 mm. A mean of more than 50 percent of the total annual precipitation occurs during October to April. The mean precipitation for this period is 400 mm, which is very similar to the Subalpine. Although snowfall is high in the Alpine, snow cover distribution is highly variable.

From long-term climate stations in the Alpine, a mean summer temperature of 6.5° was calculated, with a range of 4.0 to 7.5° C. Low mean summer temperatures set the Alpine apart from all other ecoregions. The occurrence of freezing temperatures in the Alpine is spatially variable. Exposed south-facing slopes may have freeze-free periods in excess of 25 days, but depressions and protected areas may be limited in freeze-free periods of only a few days in length. Growing degree day accumulation above 5.0° C is very small in the Alpine. It is likely that fewer than 500 degree days are accumulated, but this will depend on slope angle and orientation.

Mean January temperatures are approximately -15.0° C. This ecoregion does not experience "chinooks", and temperatures rarely, if ever,

go above 0° C during December-to-February period. Snow depth can vary from zero to several metres, and may last from a few days to years.

In the Lower Alpine, willow and dwarf birch communities and "islands" of krumholz occur. The Middle Alpine is characterized by relatively continuous heather and snowbed communities, while the Upper Alpine is poorly vegetated due to the cool summer temperatures and exposure to wind. Rocky outcrops and stonefield lichen communities are typical of the Alpine Ecoregion. Glaciers occur in the highest terrain, where snow accumulation exceeds ablation.

Such species as heathers, dryad and kobresia typify the Alpine Ecoregion.

3. METHODOLOGY

3.1 Guidelines

The purpose of the forage inventory is to establish the types of vegetation communities, including cover estimates of species and productivity that occurs within the area.

The guidelines developed by the Forage Inventory Unit provides for the systematic delineation of land areas using ecological criteria. These guidelines are based on the principles of: recognizing the geomorphic nature of the earth's surface, recognizing the different climatic zones, and being aware of the interactions and influences of these on vegetation.

Information from other resource inventory groups is collected and studied to provide background data to the forage inventory. This information includes: physical land data from the Land Classification Group, ecological land classification data from the Resource Appraisal Group, and forest cover data from the Phase III Forest Inventory Group.

The study area is stratified using ecological parameters that can be identified on small-scale photography (1:60 000). Field plot locations are selected prior to field sampling, on large-scale photography, to obtain representative samples of plant communities as they occur under different site conditions. The number of sample sites allocated to each type is based on the relative importance of that type.

For example, a large number of sites are selected in brushland areas because of their importance for grazing and due to the high variability found in them. Occasionally, access to certain areas is limited, alpine communities in particular. It is therefore only practical to attempt minimal sampling in these areas.

Previously-stratified areas are sampled for species composition and cover as well as productivity. Revisions of forage types are made, and additional areas to be sampled are included in the stratification throughout the field season as plot information is gathered. See Appendix V for plot locations.

3.2 Field Sampling

At each field site, a 5 m x 5 m plot is established to determine species composition and cover of shrubs. Specific cover values, by percent, are assigned to each species.

In addition, a 20 metre transect with five 0.5 m² plots is established to determine presence and cover by percent of forb, grass, moss, and lichen species.

Plant species are listed on the field forms according to the layer in which they occur.

The breakdown of layers is as follows:

- A₁ - overstory tree species
- A₂ - understory tree species greater than 5 metres tall
- B₁ - shrub species - 2.5 to 5 m
- B_{2a} - shrub species - 0.5 to 2.5 m
- B_{2b} - shrub species less than 0.5 m
- C - forb species
- D - grass and grass-like species
- Eb - moss species
- El - lichen species

Other information collected includes: elevation, slope, aspect, shape of slope, microrelief, site disturbance, forest cover type, age, height of forest stand, and general comments about the site.

Biomass data for forbs and grasses are collected at pre-established plots at the height of the growing season. This involves clipping the current year's growth on the same transect as was described for species composition and cover. The clips include all parts of plants that extend beyond the plot boundary. Excluded are all parts of herbaceous plants whose stems originate outside the plot, even though their foliage may overlap into the plot. This material is then air-dried and weighed and the weight converted to kilograms per hectare.

Palatable browse biomass is also determined on these pre-established plots at the end of the growing season (Appendix U). A 20 metre x 0.5 metre transect is established. Stems and twigs in the B₂ layer,

which includes those between 0.5 and 2.5 metre above ground, are counted. Note: the current year's growth over 2.5 cm constitutes a twig. These maximum and minimum heights were chosen because the former represents the average snow depth and the latter represents the maximum height at which the animals can browse. The browse biomass data, therefore, represents available browse in winter. Twigs are collected on every second plant of each species with two twigs collected from the bottom, middle, and top third of each plant.

3.3 Data Analysis

The plot data is grouped by species composition as well as by physical and ecological factors; i.e. plots having similar species presence and cover values that occur in similar ecological areas are grouped to define a forage type. The mean cover values, frequency of species occurring, and prominence index ($pi = \text{mean cover} \times \sqrt{\frac{\% \text{ frequency}}{100}}$) are calculated. The prominence index adjusts cover percentage by frequency of occurrence and, therefore, is used to determine the relative importance of each species within the community.

All plant species with a prominence index of greater than 0.5, are listed by vegetation layer in the accompanying appendices. Species with a prominence index of less than 0.5 are listed at the bottom of the page.

Only those plant species occurring in the understory and with a

prominence index of greater than 1.0 are listed in the accompanying tables. These are not listed by vegetation layer but, rather, are separated into woody and herbaceous species.

Biomass values for forbs, grasses, and palatable browse, are averaged for plots within each forage type.

3.4 Mapping

Mapping is carried out on aerial photographs with the aid of forest cover and geomorphic maps. The map units are delineated on the basis of the previously stratified areas and the ecological relationships are established through field sampling.

Each unit is assigned a forage type symbol. Any unit may contain a percentage of two different forage types. An example of a mapping symbol is as follows: $Sb_1^7 - B_1^3$. This represents an area with 70 percent of forage type Sb_1 and 30 percent of forage type B_1 . Maps at a scale of 1:50 000 are produced to show the location and extent of the forage types.

4. RESULTS AND DISCUSSION

The development of vegetation communities in the mountains and foothills is influenced by such factors as climate, elevation, slope, aspect, drainage, and parent materials. Climate, as it relates to elevation, is responsible for the zonation of vegetation patterns that can be recognized at broad levels. On a site-specific basis, aspect, slope, drainage, and parent materials interact to influence community development. Fire, which has a major effect on the ecosystems in the area, tends to increase diversity in the vegetation communities.

Lodgepole pine dominates the majority of the forest communities, with white and Engelmann spruce being locally abundant. The river valley system are very diverse in vegetation communities, with grasslands, shrublands, and forested areas occurring in a complex mosaic. The western portion of the study area is very mountainous, with alpine vegetation and exposed bedrock being dominant features.

4.1 Lodgepole Pine Forage Types

Lodgepole pine forage types are dominant in the Ram-Clearwater study area. This is due to a history of repeated and extensive fires and the ability of lodgepole pine to invade rapidly after disturbance. Major factors controlling the development of plant communities under the pine forest are: aspect, drainage, slope, and parent materials. There are four lodgepole pine forage types identified in the study area:

Lodgepole Pine-Hairy Wild Rye, Lodgepole Pine-Bog Cranberry-Feathermoss, Lodgepole Pine-Feathermoss-Lichen, and Lodgepole Pine-Bunchberry-Feathermoss.

4.1.1 Lodgepole Pine-Hairy Wild Rye

The Lodgepole Pine-Hairy Wild Rye forage type (P1) is dominated by lodgepole pine with scattered occurrences of white spruce (Table 1, Appendix B). The dominant shrub is juniper, with frequent inclusions of bearberry, twinflower, and bog cranberry. Arnica and hairy wild rye are common in the forb and grass layers respectively. Feathermoss is present in most plots; however, cover is low.

This type occurs throughout the study area in association with warm slopes with aspects varying from southeast to west. Parent materials are dominantly colluvial, with some morainal areas also occurring. The soils are generally shallow to bedrock. Slopes average 16° and elevations range from 1 430 to 1 770 in areas where sampling was done.

This forage type represents relatively dry sites, as indicated by the presence of juniper and bearberry, and by the abundance of hairy wild rye. This dryness is caused by exposure to sun and wind as well as by the rapid run-off that is a result of the steep slopes. Succession to spruce on these sites would be very slow because the microclimate created by exposure is not suitable for its establishment.

Biomass averages 55 kg/ha for grass and 43 kg/ha for forbs. No

TABLE 1
MAJOR SPECIES IN THE LODGEPOLE PINE-HAIRY WILD RYE FORAGE TYPE

Species	c	%f	pi
Woody			
Juniper	6.3	64	5.0
Bearberry	6.9	50	4.9
Twinflower	3.0	64	2.4
Bog cranberry	2.6	57	2.0
Green alder	3.9	14	1.5
Buffalo-berry	2.6	21	1.2
Prickly rose	1.6	50	1.1
Herbaceous			
Arnica	1.3	86	1.2
Hairy wild rye	2.0	92	1.9
Feathermoss	5.5	92	5.3
Peltigera spp.	9.6	86	8.9
Other lichens	1.8	86	1.7

palatable browse was observed at any of the plots established (Table 2).

4.1.2 Lodgepole Pine-Bog Cranberry-Feathermoss

The Lodgepole Pine-Bog Cranberry-Feathermoss forage type (P8) is dominated by lodgepole pine with white spruce occurring frequently (Table 3, Appendix C). The shrub layer is dominated by bog cranberry, Labrador tea, and willow. The forb layer is almost non-existent; however, a high cover of feathermoss is common.

This type occurs on cool northerly slopes in the study area. The aspects on which it is mapped are from northwest to east. The parent materials are colluvial or morainal, with shallow depths to bedrock. Slopes average 23° and elevations range from 1 490 to 1 715 m at sample plots.

The high cover of feathermoss, coupled with low forb and grass cover, and the dominance of ericaceous shrubs is indicative of the cool, moist environment of this forage type. The north slopes receive less radiation than the south slopes and therefore the available moisture is higher. The cool microclimate also restricts the number of plant species that are adapted to such sites. These sites can be expected to succeed to a spruce community type due to the cool, moist conditions.

Biomass averages 14 kg/ha for grass and 21 kg/ha for forbs (Table 2). Browse biomass was not determined due to the relative lack of palatable browse observed at the plots.

TABLE 2

BIOMASS DATA FOR RAM-CLEARWATER STUDY AREA

Community	Grass			Forbes			Palatable Biomass			Total Mean
	No.	Mean	Range	No.	Mean	Range	No.	Mean	Range	
Lodgepole Pine-Hairy Wild Rye	9	55.0	0-122.0	9	43.0	0-112.0	0			98.0
Lodgepole Pine-Bog Cranberry-Feathermoss	4	14.0	6.0-20.0	4	21.0	8.0-34.0	0			35.0
Lodgepole Pine-Feathermoss-Lichen	11	60.0	4.0-120.0	11	34.0	4.0-90.0	4	12.7	2.2-45.9	106.7
Lodgepole Pine-Bunchberry-Feathermoss	3	36.0	4.0-88.0	3	87.0	4.0-136.0	2	1.8	0.4-3.2	124.8
White Spruce-Bog Cranberry-Feathermoss	4	0	-	4	0	-	1	1.4	-	1.4
White Spruce-Twinflower-Feathermoss	2	45.0	16.0-74.0	2	96.0	86.0-106.0	2	4.8	0-9.6	145.8
Engelmann Spruce (Se.)	5	55.2	0-110.0	5	51.6	32.0-70.0	5	0	-	106.8
Dwarf Birch-Sedge-Moss	4	300.5	98.0-470.0	4	26.0	0-48.0	2	2.7	0-5.3	329.2
Dwarf Birch-Kobresia	3	159.0	52.0-306.0	3	125.0	78.0-184.0	5	4.8	0-15.7	288.8
Hair Grass	5	1050.0	552.0-1566.0	5	677.0	-	0	0	-	1727.0
Dwarf Birch-Bearberry-Hedysarum	3	99.0	68.0-140.0	3	358.0	28.0-536.0	3	24.0	2.2-55.2	481.0
Aspen-Rose-Hairy Wild Rye	2	302.0	118.0-486.0	2	442.0	98.0-786.0	2	33.4	12.8-54	777.4
Clearcut	3	293.0	158.0-496.0	3	245.0	74.0-642.0	3	35.1	0-73.1	573.1
Willow-Aster	2	3.0	2.0-4.0	2	198.0	170.0-226.0	0			201.0
Deciduous Brushlands	5	504.7	147.4-826.0	4	655.6	332.8-1032.4	3	15.5	1.7-42.8	1175.8
Tamarack Dwarf Birch-Moss	5	279.5	25.0-571.5	5	129.1	44.0-173.6	6	7.6	0.5-31	416.2

TABLE 3
MAJOR SPECIES IN THE LODGEPOLE PINE-BOG CRANBERRY-FEATHERMOSS
FORAGE TYPE

Species	c	%f	pi
Woody			
Bog cranberry	18.3	100	18.3
Labrador tea	7.0	100	7.0
Twinflower	5.0	100	5.0
White spruce	3.3	83	3.0
Buffalo-berry	2.0	33	1.1
Willow	1.7	33	1.0
Herbaceous			
Feathermoss	74.2	100	74.2
Peltigera spp.	1.8	67	1.5

4.1.3 Lodgepole Pine-Feathermoss-Lichen

The Lodgepole Pine-Feathermoss-Lichen forage type (P9) is dominated by lodgepole pine, with scattered occurrences of white spruce (Table 4, Appendix D). The shrub layer consists mainly of bog cranberry, bearberry, and willow. Herbaceous species are relatively sparse, with feathermoss and lichen species dominating the community.

This type is found mainly on coarse-textured glaciofluvial materials in the valley bottoms within the study area. As a result, slopes are gentle, and aspect does not play a significant role in the development of the community type. Elevations range from 1 340 to 1 820 m above sea level.

The species diversity in this type is small. The presence of bearberry and lichens indicate dry site conditions, as would be expected on coarse-textured parent materials.

Biomass averages 60 kg/ha for grass, 34 kg/ha for forbs, and 12.7 kg/ha for palatable browse (Table 2).

4.1.4 Lodgepole Pine-Bunchberry-Feathermoss

The Lodgepole Pine-Bunchberry-Feathermoss type (P10) is dominated by lodgepole pine, with minor occurrences of white spruce (Table 5, Appendix E). The shrub layer is variable; however, bog cranberry and twinflower are common. The forb layer is sparse, with bunchberry being

TABLE 4

MAJOR SPECIES IN THE LODGEPOLE PINE-FEATHERMOSS-LICHEN FORAGE TYPE

Species	c	%f	pi
Woody			
Bog cranberry	10.0	76	8.7
Bearberry	6.9	59	5.3
Willow	6.7	53	4.9
Twinsflower	4.4	71	3.7
Lodgepole pine	2.6	35	1.5
Labrador tea	2.2	35	1.3
Herbaceous			
Hairy wild rye	2.4	82	2.2
Feathermoss	40.8	100	40.8
Peltigera spp.	7.0	94	6.8
Other lichens	2.0	71	1.7

the only species that occurs consistently. Hairy wild rye occurs in most plots, although its cover is light. Feathermoss has a high cover value in most plots.

This type occurs in the Benchlands Physiographic Region of the study area. Slopes are generally gentle (average 1.4°) and elevations range from 1 250 m to 1 400 m a.s.l. Parent materials are generally moraine or glaciolacustrine.

Species diversity is small in this type due, in part, to the high density of the forest stands and the resulting small amount of light infiltration through the forest canopy. White spruce would be expected to take over in the next successional stage in the event that no major disturbance occurs.

Biomass averages 36 kg/ha for grass, 87 kg/ha for forbs, and 1.8 kg/ha for palatable browse (Table 2).

Discussion

Lodgepole pine communities in the study area display variation in understory vegetation largely as the result of differences in aspect, drainage, and parent materials. While none of the forage types has great species diversity, there are significant differences between them.

The higher abundance of forbs and grasses in the Lodgepole Pine-Hairy Wild Rye type illustrates the effect of warm slopes on community composition as opposed to the Lodgepole Pine-Bog Cranberry-Feathermoss

TABLE 5

MAJOR SPECIES IN THE LODGEPOLE PINE-BUNCHBERRY-FEATHERMOSS FORAGE TYPE

Species			
Woody			
Bog cranberry	20.0	75	17.3
Twinflower	13.1	87.5	12.3
Bearberry	4.6	50	3.3
Buffalo-berry	3.8	37.5	2.3
Dwarf bilberry	3.1	25	1.6
Prickly rose	2.1	37.5	1.3
Herbaceous			
Bunchberry	6.6	100	6.6
Wild lily-of-the-valley	1.5	50	1.1
Fireweed	2.4	50	1.7
Hairy wild rye	2.6	87.5	2.4
Feathermoss	65.1	100	65.1
Peltigera spp.	1.4	75	1.2

type which occurs in cool microclimates. The increase in the lichen cover in the Lodgepole Pine-Feathermoss-Lichen type indicates a dry site condition, as would be expected on a coarse-textured parent material.

All of the lodgepole pine forage types have some species in common, which is indicative of the harsh regional climate in the area. The differences in the cover of each species present, however, tends to reflect the local site conditions.

4.2 Spruce Forage Types

Spruce forage types which represent advanced successional stages are restricted in extent in the study area. The high incidence of fire has prevented the successional sequence from progressing to this stage in many areas. As would be expected, the spruce forage types are found in moist microsites, such as at high elevations or on cool northerly slopes, where the spread of fires is somewhat restricted. There are three spruce dominated forage types identified in the area: White Spruce-Bog Cranberry-Feathermoss, White Spruce-Twinflower-Feathermoss, and Engelmann Spruce.

4.2.1 White Spruce-Bog Cranberry-Feathermoss

The White Spruce-Bog Cranberry-Feathermoss forage type (Sw1) is dominated by white spruce with scattered occurrences of lodgepole pine and alpine fir (Table 6, Appendix F). Alpine fir regeneration and Labrador tea dominate the shrub layers. The forb and grass layers are very light or almost non-existent. Feathermoss cover is generally heavy.

This type occurs on northerly-facing slopes in the study area. Parent materials are either colluvial or morainal, with a shallow depth to bedrock. The average slope is 14.2° , while the average elevation is 1 700 m.

The White Spruce-Bog Cranberry-Feathermoss forage type represents an advanced successional stage. It occurs in areas that have not been burned recently. Species diversity is small due to the cool, moist conditions found on the northerly slopes, and the density of the overstory. The presence of ericaceous shrubs such as Labrador tea, cowberry, and bog cranberry indicate the cool, moist, often acidic environment.

Biomass is nil for grasses and forbs at clipped plots. Palatable browse was sampled at only one plot and consisted of 1.4 kg/ha of alpine fir (Table 2).

4.2.2 White Spruce-Twinflower-Feathermoss

The White Spruce-Twinflower-Feathermoss forage type (Sw5) is dominated by white spruce, with scattered occurrences of lodgepole pine (Table 7, Appendix G). Twinflower is the only shrub species that is found consistently. The forb and grass layers are somewhat variable; however, hairy wild rye occurs in all plots. Feathermoss cover is generally heavy.

This type occurs on fluvial parent materials in association with the major rivers and creeks in the study area. The topography is generally

TABLE 6

MAJOR SPECIES IN THE WHITE SPRUCE-BOG CRANBERRY_FEATHERMOSS FORAGE TYPE

Species	c	%f	pi
Woody			
Alpine fir	5.0	100	5.0
Labrador tea	3.6	80	3.2
Crowberry	3.0	60	2.3
Twinflower	1.6	100	1.6
White spruce	1.7	80	1.5
Herbaceous			
Feathermoss	89.0	100	89.0
Peltigera spp.	2.7	100	2.7

flat, due to the nature of the parent materials, and drainage is variable.

Species diversity is small at individual sites in these communities; however, there are substantial differences among sites due to the variability of microsites present in the fluvial systems. These stands are often interspersed with shrubland areas in the fluvial systems, resulting in complex community structure throughout the system.

Biomass averages 45 kg/ha for grass, 96 kg/ha for forbs, and 4.8 kg/ha for palatable browse (Table 2).

4.2.3 Engelmann Spruce

The Engelmann spruce-dominated forage type (Sel) consists of two distinct community types: Engelmann Spruce-Alpine Fir-Yellow Heather and Engelmann Spruce-Grouseberry (Tables 8 and 9). The Engelmann Spruce-Alpine Fir-Yellow Heather is usually found elevationally above the Engelmann Spruce-Grouseberry community. The shrub layer of both communities is dominated by ericaceous shrubs such as yellow heather and Vaccinium species. The forb and grass layers are generally sparse, with arnica and hairy wild rye occurring in most plots. Feathermoss cover is not heavy; however, Peltigera species are common in these communities.

Parent materials found in association with these types are generally colluvial or morainal. The elevation averages 2 054 m, although the communities can be expected to occur up to the tree-line in the mountains. Soil development is restricted in these areas because the ground is frozen

TABLE 7

MAJOR SPECIES IN THE WHITE SPRUCE-TWINFLOWER-FEATHERMOSS FORAGE TYPE

Species	c	%f	pi
Woody			
Twinflower	5.3	75	4.6
White spruce	2.5	25	1.3
Red-asier dogwood	2.5	25	1.3
Herbaceous			
Tall mertensia	1.8	50	1.3
Bunchberry	1.6	50	1.1
Wild strawberry	1.1	75	1.0
Hairy wild rye	2.8	100	2.8
Feathermoss	71.8	100	71.8
Peltigera spp.	2.6	100	2.6

for a lengthy portion of the year.

The Engelmann spruce communities represent advanced successional stages. Fire does not play a large role in the ecology of these stands because of the cold, moist environment. Species diversity is also restricted by the cold environment.

Biomass averages 55.2 kg/ha for grass, 51.6 kg/ha for forbs, and there is no palatable browse observed (Table 2).

Spruce Discussion

The spruce forage types in the study area occur at different locations in the topographic sequence. This affects the species occurrence within these types due to the climatic and edaphic differences. The White Spruce-Bog Cranberry-Feathermoss and White Spruce-Twinflower-Feathermoss types are floristically similar except for the higher understory species diversity in the latter. This can be attributed to the fact that the White Spruce-Twinflower-Feathermoss communities occur in more protected river valley locations where soils and climate allow for establishment of a more diverse community.

The Engelmann spruce communities represent much harsher environmental conditions than do the white spruce types. The species present indicate the harsh environment found at high elevations near tree-line.

TABLE 8

MAJOR SPECIES IN THE ENGELMANN SPRUCE-YELLOW HEATHER COMMUNITY TYPE

Species	c	%f	pi
Woody			
Yellow heather	14.0	100	14.0
Alpine fir	5.0	100	5.0
Bog cranberry	4.0	50	2.8
White mountain heather	2.5	100	2.5
Engelmann spruce	2.0	50	1.4
Herbaceous			
Stiff club moss	3.0	50	2.1
One-sided wintergreen	1.8	100	1.8
Feathermoss	24.5	100	24.5
Peltigera spp.	24.0	100	24.0

TABLE 9
MAJOR SPECIES IN THE ENGELMANN SPRUCE-GROUSEBERRY COMMUNITY TYPE

Species	c	%f	pi
Woody			
Grouseberry	29.5	100	29.5
Twinflower	3.5	50	2.5
Willow	3.0	50	2.1
Herbaceous			
Arnica	2.0	75	1.7
Hairy wild rye	3.5	100	3.5
Feathermoss	8.5	75	7.4
Peltigera spp.	10.5	75	9.1
Other lichen	1.6	75	1.4

4.3 Riparian Forage Types

The riparian communities in the study area reflect conditions where climatic, edaphic or disturbance factors have precluded the establishment of a major tree overstory. The vegetation mosaic is often complex in the river or creek valley systems, as is reflected in the variety of forage types found. These areas include shrubland and grassland communities that are not possible to map out at the 1:50 000 scale. There are three riparian forage types identified: Dwarf Birch-Sedge-Moss, Dry Brushland, and Dwarf Birch-Bearberry-Hedysarum.

4.3.1 Dwarf Birch-Sedge-Moss

The Dwarf Birch-Sedge-Moss forage type (B1) represents a complex vegetation pattern. The cover of dwarf birch and willow varies with the drainage regime at particular sites (Table 10, Appendix J). Purple avens, sedges, and mosses dominate the herbaceous layers. This type occurs in association with creek valleys and river systems in the study area and represent poorly-drained sites. Discharge water from slopes collects in the valley bottoms, resulting in the development of organic or gleysolic soils. Generally, these communities are more common in the small creek valley systems where water movement is slow compared with major river valleys.

Biomass averages 300.5 kg/ha for grass, 25 kg/ha for forbs and 27.7 kg/ha for palatable browse (Table 2). The browse biomass is low because of slow growth of birch and willow at these sites and because much

of the biomass occurs below the expected snow depth.

4.3.2 Dry Brushland

The Dry Brushland forage type (B2) is a complex of vegetation communities, namely Dwarf Birch-Aster-Rough Fescue, Dwarf Birch-Kobresia and Hair Grass Grassland. The three communities are grouped for mapping purposes, as they occur in close association in valley-bottom systems.

Shrub species within the Dwarf Birch-Aster-Rough Fescue (Table 11, Appendix K) and the Dwarf Birch-Kobresia (Table 12, Appendix L) community types are very similar with dwarf birch and willow being dominant. The Hair Grass Grassland type has no shrubs associated with it (Table 13, Appendix M). Forb and grass species vary considerably within the three community types. The Dwarf Birch-Aster-Rough Fescue type is dominated by aster, fireweed, hairy wild rye and rough fescue. Common yarrow, kobresia, and hairy wild rye are prevalent in the Dwarf Birch-Kobresia community. The Hair Grass Grassland has common yarrow, veiny meadow rue, hair grass and sedges as dominant species.

These vegetation types represent drainage regimes that range from poorly-drained to well-drained. The Hair Grass Grassland occurs in the more moist situations in the valley bottoms while the Dwarf Birch-Kobresia and Dwarf Birch-Aster-Rough Fescue represent drier locations. The Dwarf Birch-Kobresia community is more common at higher elevations than the other types; that is, it occurs more often in the Rocky Mountain physiographic

TABLE 10
MAJOR SPECIES IN THE DWARF BIRCH-SEDGE-MOSS FORAGE TYPE

Species	c	%f	pi
Woody			
Dwarf birch	33.5	100	33.5
Willow	28.8	100	28.8
Herbaceous			
Purple avens	1.7	75	1.5
Sedge spp.	6.7	100	6.7
Feathermoss	50.9	100	50.9
Sphagnum moss	4.0	25	2.0

region than in the Foothill region.

Biomass averages 1 050 kg/ha for grass, and 677 kg/ha for forbs in the Hair Grass Grassland (Table 2). The Dwarf Birch-Kobresia type has 159 kg/ha for grass, 125 kg/ha for forbs, and 4.8 kg/ha for palatable browse (Table 2). Clip plots were not established in the Dwarf Birch-Aster-Rough Fescue community due to cattle grazing in these areas.

4.3.3 Dwarf Birch-Bearberry-Hedysarum

The Dwarf Birch-Bearberry-Hedysarum type (B3) occasionally has very light lodgepole pine or white spruce cover as an overstory layer. The shrub layer is dominated by dwarf birch, willow, and bearberry (Table 14, Appendix N). Hedysarum, strawberry, and common yarrow are common forbs, while sedges dominate the grass layer. Feathermoss and lichens occur sporadically with low cover.

This type occurs on those portions of the fluvial systems where disturbance by flooding is relatively common although of short duration. Generally, soils associated with this type are coarse-textured because the materials have been deposited by fast-flowing streams.

Species composition varies between sites due to the diversity of microsites within the fluvial systems. Drainage, soil texture, and frequency of disturbance are the major factors affecting microsite conditions and stage of succession.

TABLE 11

MAJOR SPECIES IN THE DWARF BIRCH-ASTER-ROUGH FESCUE FORAGE TYPE

Species	c	%f	pi
Woody			
Dwarf birch	46.3	100	46.3
Willow	33.8	75	29.2
Shrubby cinquefoil	2.3	75	1.9
Bearberry	2.5	25	1.3
Herbaceous			
Aster	2.6	100	2.6
Fireweed	1.5	75	1.3
Meadow rue	1.1	100	1.1
Valerian	1.1	100	1.1
Common yarrow	1.0	100	1.0
Hairy wild rye	1.6	50	1.1
Rough fescue	1.3	75	1.1
Moss	1.4	75	1.2

TABLE 12
MAJOR SPECIES IN THE DWARF BIRCH-KOBRESIA COMMUNITY TYPE

Species	c	%f	pi
Woody			
Dwarf birch	35.0	100	35.0
Willow	6.7	66	5.4
Shrubby cinquefoil	2.0	50	1.4
Bearberry	2.5	33	1.4
Herbaceous			
Common yarrow	1.1	83	1.0
Kobresia	15.0	100	15.0
Hairy wild rye	2.7	83	2.5
Feathermoss	2.6	100	2.6

TABLE 13
MAJOR SPECIES IN THE HAIR GRASS COMMUNITY TYPE

Species	c	%f	pi
Herbaceous			
Common yarrow	4.2	100	4.2
Vieny meadow rue	4.4	70	3.7
Aster species	3.3	80	3.0
Cinquefoil	2.8	70	2.3
Old man's whiskers	2.3	60	1.8
Purple avens	2.1	50	1.5
Tufted hair grass	17.2	100	17.2
Sedge spp.	9.0	100	9.2
Rush spp.	1.6	70	1.3
Hairy wild rye	1.3	60	1.0

Biomass averages 99 kg/ha for grass, 358 kg/ha for frobs, and 24 kg/ha for browse (Table 2).

Discussion

The variability within the Riparian forage types can be attributed largely to different drainage regimes found in the valley bottoms. The Dwarf Birch-Sedge-Moss type represents the wettest conditions, while the Dwarf Birch-Bearberry-Hedysarum type represents the driest. The Grassland and the other Brushland types are transition stages between the two extremes. Generally, the sites nearest the rivers are driest, while those near valley slopes are wet. The gradient between these two extremes varies according to microsite conditions within each fluvial system.

4.4 Alpine Forage Types

Alpine communities in the study area are variable, depending on such factors as exposure, soil depth, moisture availability, and snow cover. Of the areas sampled, the community types found can be grouped into two main categories: those that are dominated by white dryad (Plot H-1, H-2, H-6, H-7, 40) (Appendix D) and those that have a higher abundance of forb and grass species (Plots H-8 and 47). In general, the dryad-dominated plots occur on more exposed sites than do the forb and grass-dominated plots. There are a number of other community types found in the alpine area, such as heather-dominated communities, indicating areas in which snow melt is very late, and willow-dominated communities, which indicate seepage zones, however, these were not sampled in this survey.

TABLE 14
MAJOR SPECIES IN THE DWARF BIRCH-BEARBERRY-HEDYSARUM FORAGE TYPE

Species	c	%f	pi
Woody			
Dwarf birch	38.0	80	33.9
Willow	25.4	80	22.7
Bearberry	17.6	80	15.7
Shrubby cinquefoil	6.0	80	5.3
Herbaceous			
Hedysarum	5.1	80	4.6
Wild strawberry	3.0	60	2.3
Common yarrow	1.0	100	1.0
Golden rod	1.1	80	1.0
Sedge	2.1	100	2.1
Hairy wild rye	1.5	60	1.2
Feathermoss	4.2	60	3.3
Lichen	3.0	40	1.8

Alpine vegetation was mapped above tree-line, which occurs above 2 000 m a.s.l. in this area. Soils are very poorly developed in these regions due to the cold environment and the high percentage of rock fragments present.

The variation in the communities found and the limited number of plots established in the alpine area do not permit averaging of biomass data; however, data for individual plots is given.

4.5 Aspen Forage Type

Aspen occurs only on certain protected microsites in the study area because the regional climate is too harsh for its wide spread establishment. There is only one Aspen-dominated forage type identified in the area.

4.5.1 Aspen-Rose-Hairy Wild Rye

The Aspen-Rose-Hairy Wild Rye forage type (A1) is dominated by trembling aspen. Rose, raspberry, and saskatoon are common shrubs (Table 15, Appendix P). Fireweed, peavine and wild strawberry occur frequently in the forb layer. Hairy wild rye is the dominant grass. The moss layer is poorly developed with low cover.

This type most commonly occurs in the Benchlands physiographic region of the study area. Generally, it is found on southerly-facing slopes where the microclimate is warm enough for the establishment of aspen stands. Some small aspen stands also occur in the foothills area on

steep southerly slopes adjacent to valley bottoms. They occur as narrow strips below the pine forest and above valley-bottom shrublands.

Species diversity is great due to the warm microclimate associated with the type. Species such as rose, raspberry, and saskatoon, which do not commonly grow in the cool climate of the foothills and mountains, are able to establish under the warmer conditions.

Biomass averages 302 kg/ha for grass, 442 kg/ha for forbs, and 33.4 kg/ha for palatable browse (Table 2).

4.6 Disturbed Area Forage Types

Three forage types in the study area have developed after recent major disturbances: clearcuts, selective cuts, and burns. These disturbances result in the development of highly variable plant communities representing early successional stages.

4.6.1 Clearcut (D1)

A limited amount of logging has been conducted in the study area. The plant communities that develop after this disturbance reflect both remnant vegetation from the original stands and invader species that have assumed dominance after disturbance (Table 16, Appendix Q). The plots sampled display considerable variability in community structure and development due to the different climatic factors that influence the particular sites. For example, Plot Number 10, which occurs at an elevation of 1 700 m, has a smaller species diversity than do plots 18 and 80,

TABLE 15
MAJOR SPECIES IN THE ASPEN-ROSE-HAIRY WILD RYE FORAGE TYPE

Species	c	%f	pi
Woody			
Prickly rose	16.3	100	16.3
Wild red raspberry	7.5	75	6.5
Saskatoon	6.0	75	5.2
Snowberry	5.5	75	4.8
Trembling aspen	4.3	75	3.7
Ground juniper	5.0	25	2.5
Chokecherry	3.8	25	2.5
Bracted honeysuckle	2.5	50	1.8
Herbaceous			
Fireweed	5.5	100	5.5
Pea vine	3.5	100	3.5
Wild strawberry	3.3	100	3.3
Tall mertensia	3.1	75	2.7
Wild vetch	1.9	100	1.9
Showy aster	1.3	75	1.1
Northern bedstraw	1.0	100	1.0
Hairy wild rye	6.0	100	6.0

TABLE 16
MAJOR SPECIES IN THE CLEARCUT FORAGE TYPE

Species	c	%f	pi
Woody			
Lodgepole pine	10.0	67	8.2
Twinflower	7.7	67	6.3
Dwarf bilberry	5.3	100	5.3
Willow	5.0	67	4.1
Trembling aspen	5.0	33	2.9
Prickly rose	3.3	67	2.7
Lodgepole pine	2.7	67	2.2
Lowbrush cranberry	3.3	33	1.9
Wild red raspberry	2.1	67	1.7
White meadowsweet	2.3	33	1.3
Buffaloberry	1.7	33	1.0
Bog cranberry	1.7	33	1.0
Herbaceous			
Bunchberry	6.0	100	6.0
Fireweed	5.3	100	5.3
Aster	1.7	67	1.4
Reed grass	3.3	100	3.3
Hairy wild rye	3.7	67	3.0
Feathermoss	8.3	100	8.3

which are located below 1 400 m elevation, indicating that more plant species are able to survive the warmer climate at lower elevations.

Biomass averages 293 kg/ha for grass, 245 kg/ha for forbs, and 35.1 kg/ha for palatable browse (Table 2).

4.6.2 Willow-Aster-Brushland

The Willow-Aster-Brushland forage type (B4) represents areas at high elevations near tree-line in the mountains where there has been disturbance by fire. Willow is the dominant shrub (Table 17, Appendix R), with aster, ragwort, pussy-toes, and sibbaldia common in the forb layer. Engelmann spruce regeneration occurs frequently at these sites.

These areas do not regenerate to lodgepole pine after fire because the climate is not suitable for its establishment. The successional sequence would lead to the development of open Engelmann spruce stands similar to the S1 forage type.

Biomass averages 3 kg/ha for grass, and 198 kg/ha for forbs (Table 2). Palatable browse was not sampled .

4.6.3 Deciduous Brushlands

The Deciduous Brushlands forage type (B5) in the study area represents disturbance by logging that occurred more than 15 years ago. This disturbance was restricted to the eastern edge of the Ram-Clearwater area where some selective cutting has occurred. There are no plots

TABLE 17

MAJOR SPECIES IN THE WILLOW-ASTER FORAGE TYPE

Species	c	%f	pi
Woody			
Willow	62.5	100	62.5
Dwarf birch	5.0	50	3.5
Willow (<i>Salix nivalis</i>)	3.0	100	3.0
Herbaceous			
Aster	4.5	100	4.5
Ragwort	4.0	100	4.0
Pussy-toes	3.0	100	3.0
Sibbaldia	3.0	100	3.0
Globe flower	3.5	50	2.5
Potentilla	2.3	100	2.3
Fireweed	2.0	100	2.0
Fleabane	2.0	50	1.4
Feathermoss	20.5	100	20.5
Peltigera lichen	5.3	100	5.3

established at these sites; however, data from the adjacent Rocky-North Saskatchewan study (1980) is presented (Table 18, Appendix S).

Biomass averages 504.7 kg/ha for grass, 655.6 kg/ha for forbs, and 15.5 kg/ha for palatable browse (Table 2).

Discussion

The forage types that have developed after disturbance have different plant communities as a result of the climatic factors associated with them. Biomass is highest in the Deciduous Brushland type, which has the warmest climatic regime. The low production in the Willow-Aster-Brushland type reflects the cold climate that is prevalent near tree-line.

4.7 Other Forage Types

4.7.1 Tamarack-Dwarf Birch-Moss

The Tamarack-Dwarf Birch-Moss forage type occurs to a limited extent in the Benchland physiographic region of the study area on poorly-drained organic soils. As the Tamarack-Dwarf Birch-Moss type was not sampled in this study, data from the Rocky-North Saskatchewan study (1980) area is given (Table 19, Appendix T). Tamarack is the dominant tree species; however, cover is generally light. Dwarf birch, willow, and tamarack are common in the shrub layer while three-leaved Solomon's-seal and buckbean are the dominant forbs. Sedges and rushes are common in the grass layer. The moss layer has high cover values and consists mainly of

TABLE 18

MAJOR SPECIES IN THE DECIDUOUS BRUSHLANDS TYPE (B5)
(DATA FROM ROCKY-NORTH SASKATCHEWAN STUDY AREA)

Species	c	%f	pi
Woody			
Green alder	12.2	67	10.0
Lowbush cranberry	10.4	44	6.9
Trembling aspen	10.3	44	6.8
Prickly rose	7.7	78	6.8
Bracted honeysuckle	6.6	44	4.4
Subalpine fir	4.6	33	2.6
Twinflower	3.0	56	2.2
Wild red raspberry	2.7	44	1.8
Currant	2.0	67	1.6
Paper birch	4.2	11	1.4
Herbaceous			
Fireweed	7.1	100	7.1
Bunchberry	3.0	78	2.6
Tall mertensia	2.5	100	2.5
Cow parsnip	3.6	44	2.4
Wild sarsaparilla	2.4	56	1.8
Arnica	1.7	78	1.5
Dewberry	1.3	67	1.1
Hairy wild rye	7.7	78	6.8
Reed grass	5.6	78	6.8
Moss	6.9	67	5.6

TABLE 19

MAJOR SPECIES IN THE TAMARACK-DWARF BIRCH-MOSS FORAGE TYPE (L1)
(DATA FROM ROCKY-NORTH SASKATCHEWAN STUDY AREA)

Species	c	%f	pi
Woody			
Dwarf birch	41.5	100	41.5
Willow	11.4	91	10.9
Tamarack	13.5	55	10.0
Black spruce	7.0	64	5.6
Labrador tea	5.8	55	4.3
Herbaceous			
Three-leaved Solomon's-seal	5.0	82	4.5
Buckbean	3.3	55	2.4
Sedge	21.4	100	21.4
Rush	8.6	55	6.4
Moss	59.7	100	59.7

sphagnum mosses.

Biomass averages 279.5 kg/ha for grass, 129.1 kg/ha for forbs and 7.6 kg/ha for palatable browse (Table 2).

4.7.2 Exposed Areas

The Rocky Mountains physiographic region of the study area has large areas of exposed bedrock in which vegetation is almost non-existent. These bedrock ridges are mapped with the symbol "E" to denote exposed areas.

4.7.3 Cultivated Land

There are small areas of cultivated land in the far south-eastern portion of the study area. These are mapped with the symbol D_2 . No data was collected in these highly-disturbed areas.

5. SUMMARY AND CONCLUSIONS

Vegetation communities in the Ram-Clearwater study area reflect the harsh regional climate that is common in mountain areas. Local variations in vegetation pattern are influenced by microclimate, parent materials and soils, drainage, and disturbance factors. Combinations of these factors interact to develop a complex vegetation mosaic. There are 18 forage types identified in the study area. Of these, none are forest-dominated, four are shrubland, three are influenced by major disturbance, one is alpine meadow and another represents bare bedrock.

Lodgepole pine communities dominate the vegetation throughout the area. This is a result of the extensive fire history in this locale. Aspect is one of the most important factors affecting community composition in the lodgepole pine types. The diversity of vegetation increases or decreases depending on aspect. Parent materials and drainage effect community structure in localized areas. Generally, the lodgepole pine forage types represent early successional stages; however, in some cases they are considered climatic or edaphic climaxes.

The spruce-dominated forage types are more sporadic in distribution. They represent advanced successional stages and, as such, have been protected from fire for relatively long periods of time. The white spruce types occur at lower elevations than do the Engelmann spruce. Species diversity in the understory is small in both cases due to the harsh regional climate and the cool microsites on which these types are found.

Shrubland communities are common in the river and creek valleys in the study area. They occur mainly as a complex of vegetation types, with grasslands and shrublands representing different drainage regimes. The larger fluvial systems generally have more communities, representing drier sites, than the smaller systems, which are generally poorly drained. Biomass is high in these communities, as would be expected with grass and shrubland vegetation.

There are two types of disturbances affecting vegetation communities in the area. Logging has been carried out to a limited extent and recent fires have affected community development. The three forage types affected by these disturbances (D1, B4, and B5) have a variable species composition because of the early successional stage they represent. Biomass is usually increased by the disturbance.

Alpine communities generally occur above 2 000 m in the study area. These are variable and depend on such factors as exposure, soil depth, and local drainage. Steep, rugged bedrock ridges which are common in the Alpine zone, usually have very sparse vegetation and are mapped as "E". The more eroded, rounded ridges above 2 000 m usually have a more continuous vegetation cover.

The Benchlands physiographic region has three forage types that do not occur in the Foothill and mountain areas. The Tamarack-Dwarf Birch-Moss type is restricted to very poorly-drained areas in the region, while the Aspen-Rose-Hairy Wild Rye community type occurs on well-drained, warm

microsites. A small amount of cultivated land exists in the benchlands area and is mapped as D2.

APPENDICES

APPENDIX A
FOOTNOTES TO APPENDICES B-X

Species Composition

Abbreviations:	c = percent cover
	f = percent frequency
	pi = prominence index = $c \times \sqrt{f \div 100}$
	A1 = overstory tree species
	A2 = understory tree species greater than 5 metres tall
	B1 = shrub species 2.5-5.0 metres
	B2 _a = shrub species 0.5-2.5 metres
	B2 _b = shrub species less than 0.5 metres
	C = forb species
	D = grass and grass-like species
	Eb = moss species
	E1 = lichen species

Cover Estimates of All Species: Represents the exact cover value of that species.

Biomass: Kilograms per hectare, air-dry basis.

Parent Materials

M = moraine, GF = glaciofluvial, L = lacustrine, F = fluvial,
E = eolian, GL = glaciolacustrine, P = saprolite, R = rock,
O = organic, v = veneer, b = blanket

APPENDIX B
PLOT DATA FOR FORAGE TYPE LODGEPOLE PINE-ELYNUS (P1)

Plot No.	5	6	22	45	54	55	56	60	61	62	65	66	110	114
Parent Material	Cyb R	Cyb R	Cyb R	Cb R	Cyb R	Cyb R	Cyb R	Cyb R	Cyb R	Cyb R	Cyb R	Cyb R	Cyb R	Cyb R
Degrees Slope	15	16	27	4	25	11	16	16	13	16	14	14	35	4
Elevation (metres)	1570	1575	1430	1760	1530	1590	1630	1730	1660	1620	1715	1770	1510	1565
Aspect	SW	SW	SW	E	ENE	SSW	SW	SW	S	S	W	W	SW	S
Forest Cover Type	D2P	D2P	D1P	D0P	D2P	BWP	D2P	D2P	A2P	D2P	C3Psw	D2P	D2P	C1Psw
Date	05/06	05/06	07/06	29/06	18/06	18/06	18/06	18/06	18/06	18/06	18/06	18/06	20/07	23/08
Biomass (kg/ha):														
Grass	42				84	56	32	94		86	0	20		122
Forbs	112				44	60	26	0		48	0	12		88
Browse	0				0	0	0	0		0	0	0		0
Species	Percent Cover													
													Sum	SE
A1 Pin co	30.0	60.0	55.0		75.0	5.0	50.0	40.0	25.0	30.0	50.0	60.0	60.0	60.0
A2 Pin co	8.0	6.0	10.0			20.0	25.0	20.0	20.0	20.0	3.0	10.0	40.0	172.0
Pic gl						5.0		40.0			2.0		0.5	47.5
B1 Pin co				85.0	2.0	8.0	5.0				3.0	5.0		108.0
Aln cr	55.0	40.0				7.0	20.0			2.0				95.0
Pic gl			5.0											34.0
B2a Aln cr	15.0	40.0												55.0
She ca			15.0									2.0	20.0	37.0
B2b Jun co			3.0	0.5	5.0	5.0			25.0	25.0	5.0	15.0	4.0	87.5
Arc uv			10.0	3.0	45.0	10.0			6.0	20.0				96.0
Lir bo		5.0		5.0	10.0	2.0	10.0		3.0		2.0	2.0		42.0
Vac vi	2.0			20.0	2.0	5.0	1.0				3.0	2.0		37.0
Mos ac		8.0	5.0	5.0				2.0	1.0				0.5	22.5
Abt la				2.0	0.5			3.0			5.0	2.0		13.5
C Arn co	1.0	3.0		1.0	4.0	1.0	1.0		2.0	1.0	0.5	1.0	1.0	17.5
D Ely in	2.0	1.0	4.0	4.0	2.0	4.0	2.0	0.5		1.0	3.0	0.5	1.0	28.0
Eb F Moss	20.0	1.0	4.0	14.0	7.0	12.0	2.0	4.0		6.0	1.0	5.0	0.5	77.5
E1 Pel spp.			3.0	8.0	27.0	20.0	15.0	10.0	30.0	2.0	3.0	3.0	2.0	134.0
Lichen			0.5	0.5	0.5	3.0	0.5	15.0	0.5	2.0	0.5	1.0	0.5	25.0

NOTE: Species with pl. 0.5: Pop tr, Sal spp., Bet gl, Pot fr, Spl lu, Vac ca, Vac me, Emp ni, Vac sc, Vib ed, Epi an, Zyg el, Fra vi, Equi sc, Pyr as, Lat oc, Gal bo, Vio ad, Cor ca, Ped co, Ast spp., Ant spp., Mal ca, Ast ca, Vlc ap, Hed na, Vio re, Equi spp., Mer pa, Psa spp., Car spp., Cal ru, Jun spp.

APPENDIX C

PLOT DATA FOR FORAGE TYPE LODGEPOLE PINE-BOG CRANBERRY-FEATHERMOSS (P8)

Plot No.	8	15	16	34	38	53				
Parent Material	Cv R	Cvb R	Cvb R	Cvb R	Cvb R	Cvb R				
Degrees Slope	37	16	16	30	27	13				
Elevation (metres)	1490	1620	1515	1715	1540	1520				
Aspect	NE	N	E	N	NNE	E				
Forest Cover Type	D2P	C1P	C2P	D2P(Sw)	D2PSw	D2P(Sw)				
Date	06/06	07/06	07/06	09/06	29/06	18/06				
Biomass (kg/ha):										
Grass	14			14	6	20				
Forbs	8			20	34	20				
Browse										
Species	Percent Cover						Sum	X	%f	pi
A1 Pin co	45.0	10.0	55.0	40.0	10.0	40.0	200.0	33.3	100	33.3
Pic gl	15.0		5.0		5.0		25.0	4.2	50	3.0
A2 Pin co	5.0	20.0	10.0	20.0	20.0	20.0	95.0	15.8	100	15.8
Pic gl	5.0				35.0		40.0	6.7	33	3.8
B1 Aln cr		25.0					25.0	4.2	17	1.7
Pic gl		3.0					18.0	3.0	33	1.7
Pic ma		1.0			5.0		6.0	1.0	33	0.6
B2a Pic gl	2.0	5.0	3.0	5.0		5.0	20.0	3.3	83	3.0
She ca				6.0		6.0	12.0	2.0	33	1.1
Sal spp.				5.0		5.0	10.0	1.7	33	1.0
B2b Vac vi	35.0	20.0	15.0	15.0	10.0	15.0	110.0	18.3	100	18.3
Led gr	5.0	1.0	15.0	3.0	15.0	3.0	42.0	7.0	100	7.0
Lin bo	10.0	3.0	5.0	5.0	2.0	5.0	30.0	5.0	100	5.0
Jun co	15.0						15.0	2.5	17	0.5
Emp ni					10.0		10.0	1.7	17	0.7
Pic gl			3.0				8.0	1.3	33	0.7
Vac ca			3.0	1.0		1.0	5.0	0.8	50	0.6
D Ely in	0.5	2.0	1.0			1.0	4.5	0.8	67	0.7
Eb F moss	75.0	95.0	100.0	38.0	99.0	38.0	445.0	74.2	100	74.2
EL Pel spp.	2.0	1.0	3.0		5.0		11.0	1.8	67	1.5
Lichen		0.5	0.5	2.0		2.0	5.0	0.8	67	0.7

NOTE: Species with pi 0.5: Ros ac, Pyr se, Pyr as, Arn co, Ste ac, Ast ei, Epi an, Hab ob, Cor ca, Lyc an, Poa spp., Bro spp., Dry pu

APPENDIX D
PLOT DATA FOR FORAGE TYPE LODGEPOLE PINE-FEATHERMOSS-LICHEN (P9)

Plot No.	1	7	12	14	20	23	24	25	26	31	33	46	46	64	87	92	116
Parent Material	GF	Fo	Fo	Cyb R	GF	FF	GF	GF	GF	GF	GF	GF	Cyb R	F1	Mab R	GF	Fo
Degrees Slope	-	8	-	3	-	-	-	-	-	6	-	-	-	3	-	-	-
Elevation(m)	1440	1400	1500	1540	1340	1670	1660	1600	1610	1820	1590	1790	1770	1720	1620	1260	1555
Aspect	-	S	-	NE	-	-	-	-	-	S	-	-	-	NE	-	-	-
Forest Cover Type	C1P	D2P	C2P (Sw)	D1P	D2P	C1P Sw	C1SwF	C2SwF	D2P (Sw)	B2PSw	B2P	C1P	C1P	C3PSw	B1P	C1P	B3PSw
Date	05/06	06/06	06/06	07/06	07/06	09/06	09/06	09/06	09/06	17/06	09/06	27/06	27/06	18/06	25/06	25/06	23/06
Biomass (kg/ha):																	
Grass	44	10	4	58	108	120	108		26	86	54		44				
Forbs	6	18	14	4	54	90	40		34	42	38		34				
Browse			0				45.9			2.2	2.6						
Species	Percent Cover																Sum
A1 Pin co	45.0	10.0	20.0	60.0	45.0	8.0	20.0	10.0	60.0	20.0	15.0	70.0	60.0	50.0	30.0	30.0	565.0
Pic gl	5.0		25.0			7.0	20.0	40.0									97.0
A2 Pin co	10.0	25.0		5.0	15.0	10.0	17.0	10.0	5.0	18.0	30.0		5.0	30.0	5.0	20.0	193.0
Pic gl			10.0	2.0		30.0	10.0		5.0	17.0	3.0			5.0			92.0
B1 Pin co	5.0		5.0	15.0	7.0	5.0	5.0	5.0	5.0	2.0		20.0	2.0	15.0	3.0	10.0	109.0
Pic gl	2.0					12.0	5.0				50.0		5.0			2.0	76.5
B2a Sal spp.					3.0	50.0	30.0		5.0	2.0			5.0	4.0		5.0	114.0
Pin co	5.0		5.0			3.0						20.0	5.0		6.0		44.0
Pic gl	5.0		2.0		4.0								5.0	4.0			20.5
She ca					5.0	5.0							2.0			5.0	17.0
B2b Vac vi	15.0	35.0		3.0	15.0	8.0	10.0	10.0		18.0		3.0	3.0	8.0	30.0	12.0	170.0
Arc uv	17.0	5.0		4.0	35.0	5.0			2.0	6.0	15.0			8.0	20.0		117.0
Lin bo	2.0	15.0		1.0	5.0	10.0	20.0	0.5		8.0		2.0	3.0	3.0	5.0		74.5
Led gr	3.0	20.0										3.0	2.0	3.0		7.0	38.0
Emp ni									5.0					40.0			45.0
Vac ca		5.0												20.0		5.0	30.0
C Epi an	0.5				1.0	1.0	0.5		0.5	0.5	0.5	3.0	1.0	0.5	1.0	1.0	11.5
D Ely in	3.0	0.5		3.0	3.0	9.0	4.0		2.0	0.5	2.0	3.1	1.0		4.0	6.0	41.5
Lb Feet moss	50.0	38.0	81.0	22.0	66.0	27.0	16.0	77.0	75.0	38.0	1.5	1.0	18.0	100.0	0.5	32.0	893.0
EL Pel spp.	0.5	12.0	0.5	1.0		2.0	14.0	10.0	17.0	10.0	10.0	3.0	9.0	6.0	4.0	9.0	116.5
Lichen	15.0	0.5	0.5			3.0	2.0			0.5	4.0	3.0	1.0		3.0	0.5	33.5

NOTE: Species with pi 0.5: Abi la, Pop tr, Pic ma, Bet gl, Ros ac, Vac sc, Vac me, Pot fr, Jun co, Fra vi, Zyg el, Arn co, Ast ci, And ch, Cor ca, Mal ca, Pyr as, Mab ab, Pyr se, Ely sc, Mer pa, Sol spp., Ste oc, Del gl, Ach ni, Ant spp., Ely spp., Pea spp., Car spp., Cal ra, Jun spp.

APPENDIX E
PLOT DATA FOR FORAGE TYPE LODGEPOLE PINE-BUNCHBERRY-FEATHERMOSS (P10)

Plot No.	19	69	72	74	76	77	78	79
Parent Material	Mb R	Mvb R	Mvb R	Mvb R	Mvb R	Mvb R	Mvb R	Mvb R
Degrees Slope	0	4	0	5	0	0	2	0
Elevation (metre)	1385	1265	1300	1400	1250	1280	1320	1310
Aspect	-	W	-	S	-	-	S	-
Forest Cover Type	D2P	C3PSw	D2P	C2P	D2P	D3P	C2P	D3P
Date	07/06	23/06	23/06	23/06	21/07	23/06	23/06	23/06
Biomass (kg/ha):								
Grass	88	16						4
Forbs	40	86						136
Browse		0.4						3.2
Species								
Percent Cover								
Sum								
X								
%								
pi								
A1 Pin co Pic gl	60.0	25.0 25.0	60.0	45.0	75.0	70.0	45.0	65.0
A2 Pin co Pic gl	15.0	3.0 3.0	40.0	35.0	5.0	5.0	35.0	
B1 Aln cr Pic gl Pop tr	35.0	2.0	2.0 2.0 1.0	80.0 10.0 6.0	2.0	5.0 5.0	20.0	1.0 7.0
B2a She ca Ros ac Aln cr			15.0 5.0	2.0 5.0		10.0	10.0	5.0
B2b Vac vi Lin bo Arc uv Vac ca Sal spp. Ros ac led gr Spi lu	10.0	5.0 5.0	50.0 5.0 2.0 15.0	35.0 10.0	45.0 5.0	15.0 15.0	40.0 20.0 20.0 10.0 5.0 5.0	5.0 15.0
C Cor ca Epi an Mai ca Pyr as Ste oc	1.0 0.5 0.5	6.0 0.5 0.5	5.0 0.5	2.0 17.0	7.0 1.0	18.0	2.0	12.0
D Ely in	5.0	3.0	1.0		2.0	9.0	0.5	0.5
Eb F moss	57.0	10.0	100.0	18.0	65.0	90.0	97.0	84.0
E1 Pel spp.	2.0	3.0	1.0		1.0	1.0	3.0	

NOTE: Species with pi 0.5: Arn co, Ast ci, Gal bo, Fra vi, Hab ob, Pyr se, Gal tr, Pet pa, Mit nu, Vio re, Cal ru, Bro spp., Lichen

APPENDIX F

PLOT DATA FOR FORAGE TYPE WHITE SPRUCE-BOG CRANBERRY-FEATHERMOSS (Sw1)

Plot No.	11	52	57	58	63				
Parent Material	Cvb R	Cvb R	Cvb R	Cvb R	Cvb R				
Degrees Slope	11	33	22	3	2				
Elevation (metres)	1715	1600	1630	1705	1825				
Aspect	SW	NE	N	N	N				
Forest Cover Type	D3Sw	D1P	D2SwP(Sb)	D2SwP(Sb)	D2P				
Date	06/06	18/06	17/06	17/06	17/06				
Biomass (kg/ha):									
Grass	0		0	0	0				
Forbs	0		0	0	0				
Browse	1.4		0		0				
Species									
	Percent Cover					Sum	$\bar{X}$	%f	pi
A1 Pic gl	40.0	25.0	35.0	30.0	25.0	155.0	31.0	100	31.0
Pin co	20.0	0.5	5.0	15.0	10.0	50.5	10.1	100	10.1
Abi la	15.0			5.0	10.0	30.0	6.0	60	4.6
A2 Pic gl	5.0	30.0	35.0	40.0	15.0	125.0	25.0	100	25.0
Pin co		15.0	5.0		15.0	35.0	7.0	60	5.4
B1 Pic gl	5.0	8.0	8.0	3.0	1.0	25.0	5.0	100	5.0
Abi la		2.0		2.0	4.0	8.0	1.6	60	1.2
B2a Abi la	15.0	5.0	2.0	1.0	2.0	25.0	5.0	100	5.0
Pic gl	5.0	0.5	2.0	1.0		8.5	1.7	80	1.5
B2b Led gr		10.0	4.0	2.0	2.0	18.0	3.6	80	3.2
Emp ni		10.0	3.0		2.0	15.0	3.0	60	2.3
Lin bo	5.0	0.5	1.0	1.0	0.5	8.0	1.6	100	1.6
Vac vi		2.0	1.0	1.0	1.0	5.0	1.0	80	0.9
Abi la	5.0				2.0	7.0	1.4	40	0.9
C Cor ca			2.0	0.5	0.5	3.0	0.6	60	0.5
Eb Feathermoss	58.0	99.0	95.0	93.0	100.0	445.0	89.0	100	89.0
EL Pel spp.	3.0	6.0	0.5	2.0	2.0	13.5	2.7	100	2.7

NOTE: Species with pi 0.5: Vac ca, Pyr se, Pyr as, Ely in, Lichen spp.

APPENDIX G

PLOT DATA FOR FORAGE TYPE WHITE SPRUCE-TWINFLOWER-FEATHERMOSS (Sw5)

Plot No.	9	17	49	50				
Parent Material	F	F	Fo	Fo				
Degrees Slope	-	2	-	-				
Elevation (metres)	1370	1300	1460	1440				
Aspect	-	-	-	-				
Forest Cover Type	C3SwP	C2Sw	D2Sw	C2Sw				
Date	06/06	07/06	29/06	29/06				
Biomass (kg/ha):								
Grass	16	74						
Forbs	86	106						
Browse	0	9.6						
Species	Percent Cover				Sum	$\bar{x}$	Σf	pi
A1 Pic gl	30.0	25.0	65.0	35.0	155.0	38.8	100	38.8
Pin co	10.0			0.5	10.5	2.6	50	1.8
Pop ba		5.0			5.0	1.3	25	0.7
A2 Pic gl	5.0	30.0	10.0	25.0	70.0	17.5	100	17.5
B1 Pic gl	2.0	35.0	3.0	5.0	45.0	11.3	100	11.3
B2a Pic gl		10.0			10.0	2.5	25	1.3
Cor st		10.0			10.0	2.5	25	1.3
Ele co		5.0			5.0	1.3	25	0.7
B2b Lin bo		15.0	1.0	5.0	21.0	5.3	75	4.6
Ros ac		7.0			7.0	1.8	25	0.9
C Mer pa			2.0	5.0	7.0	1.8	50	1.3
Cor ca	6.0	0.5			6.5	1.6	50	1.1
Fra vi		2.0	0.5	2.0	4.5	1.1	75	1.0
D Ely in	1.0	1.0	6.0	3.0	11.0	2.8	100	2.8
Eb F moss	98.0	19.0	80.0	90.0	287.0	71.8	100	71.8
EL Pel spp.	8.0	0.5	1.0	1.0	10.5	2.6	100	2.6

NOTE: Species with pi 0.5: Pop tr, Vac ca, Pyr se, Smi st, Pyr as, Hed ma, Epi an, Pet pa, Equ se, Del gl, Sol spp., Car spp.

APPENDIX H

PLOT DATA FOR COMMUNITY TYPE ENGELMANN SPRUCE-ALPINE FIR-YELLOW HEATHER (Se.)

Plot No.	41	42					
Parent Material	Cb R	Cb R					
Degrees Slope	16	19					
Elevation (metres)	2100	2080					
Aspect	N	N					
Forest Cover Type	B2Sw Fb(P)	C2 SwFb(P)					
Date	29/06	29/06					
Biomass (kg/ha):							
Grass	10	0					
Forbs	46	48					
Browse	0	0					
Species	Percent Cover		Sum	$\bar{x}$	%f	pi	
A1	Pic en	15.0	30.0	45.0	22.5	100	22.5
	Abi la	5.0		5.0	2.5	50	1.8
A2	Pic en	25.0	38.0	63.0	31.5	100	31.5
	Abi la	10.0	20.0	30.0	15.0	100	15.0
	Pin co	1.0	2.0	3.0	1.5	100	1.5
B1	Abi la	20.0	8.0	28.0	14.0	100	14.0
	Pic en	20.0	2.0	22.0	11.0	100	11.0
B2a	Pic en	4.0		4.0	2.0	50	1.4
	Abi la	4.0		4.0	2.0	50	1.4
B2b	Phy gl	25.0	3.0	28.0	14.0	100	14.0
	Abi la	3.0	3.0	6.0	3.0	100	3.0
	Vac vi		8.0	8.0	4.0	50	2.8
	Cas te	1.0	4.0	5.0	2.5	100	2.5
	Sal spp.	1.0	0.5	1.5	0.8	100	0.8
C	Lyc en		6.0	6.0	3.0	50	2.1
	Pyr se	0.5	3.0	3.5	1.8	100	1.8
D	Ely in	0.5	0.5	1.0	0.5	100	0.5
Eb	Feathermoss	36.0	13.0	49.0	24.5	100	24.5
E1	Pel spp.	20.0	28.0	48.0	24.0	100	24.0
	Lichen	1.0	0.5	1.5	0.8	100	0.8

NOTE: Species with pi 0.5: Vac sc, Led gr, Ped br, Ast ci, Arn co, Sol spp., Pol vi, Mon un, Equ se, Cal ra

APPENDIX I
PLOT DATA FOR COMMUNITY TYPE ENGLEMANN SPRUCE-GROUSEBERRY (Se1)

Plot No.	28	43	H-3	H-4				
Parent Material	$\frac{Cvb}{R}$	$\frac{Cb}{R}$	$\frac{Cvb}{R}$	$\frac{Ffvb}{GF}$				
Degrees Slope	2	-	22	2				
Elevation (metres)	1940	2060	2200	1945				
Aspect	SE	-	SE	W				
Forest Cover Type	A3Sw C6Sw(P)	C2Sw(P)	B1PSw	C1PSw				
Date	17/06	29/06	08/08	08/08				
Biomass (kg/ha):								
Grass		62	94	110				
Forbs		32	70	62				
Browse		0	0	0				
Species	Percent Cover				Sum	$\bar{x}$	zf	pi
A1 Pin co	0.5	5.0	45.0	50.0	100.5	25.1	100	25.1
Pic en	5.0	15.0		5.0	25.0	6.3	75	5.5
A2 Pin co	10.0	30.0	1.0	4.0	45.0	11.3	100	11.3
Pic en	15.0	15.0	2.0	1.0	33.0	8.3	100	8.3
Abi la		1.0	1.0		3.0	0.8	50	0.6
B1 Pic en	21.0	10.0		2.0	37.0	9.3	75	8.1
Pin co	5.0	20.0		2.0	27.0	6.8	75	5.9
B2a Sal spp.			10.0	2.0	12.0	3.0	50	2.1
B2b Vac sc	25.0	45.0	45.0	3.0	118.0	29.5	100	29.5
Lin bo	10.0			4.0	14.0	3.5	50	2.5
C Arn co	1.0		5.0	2.0	8.0	2.0	75	1.7
Hed ma			6.0		6.0	1.5	25	0.8
Epi an			3.0	1.0	4.0	1.0	25	0.5
D Ely in	1.0	1.0	8.0	4.0	14.0	3.5	100	3.5
Eb Feathermoss	11.0	21.0		2.0	34.0	8.5	75	7.4
E1 Pel spp.	18.0	11.0		13.0	42.0	10.5	75	9.1
Lichen	4.0	0.5		2.0	6.5	1.6	75	1.4

NOTE: Species with pi 0.5: Bet gl, She co, Epi en, Pyr se, Ast ci, Ach ml, Ago an, Sol spp., Pot di, Ant spp., Gen pr, Car spp.

APPENDIX J
PLOT DATA FOR FORAGE TYPE DWARF BIRCH-SEDE-MOSS (B1)

Plot No.	3a	27	71	88	89	100	101	104	105	109	111c	113d					
Parent Material	OvD CL	M	OvD M	Hub M	OvD CL	GF	GF	Hub M	Hub M	Pa	Pa	Pa					
Degrees Slope	-	-	-	-	-	-	-	1	1	-	-	-					
Elevation (metres)	1410	1485	1275	1420	1435	1400	1410	1540	1400	1500	1495	1530					
Aspect	-	-	-	-	-	-	-	S	SW	-	-	-					
Date	06/06	09/06	21/07	25/06	25/06	07/07	07/07	09/07	09/07	09/07	22/07	26/07					
Biomass (kg/ha):																	
Grass				168		470	468					98					
Forbs				48		0	30					24					
Browse						0	5.3										
Species	Percent Cover											Sum	X	SE	pl		
B2a	Bet gl	65.0		40.0	10.0		35.0	10.0	20.0	5.0	20.0	35.0	50.0	290.0	24.2	83	22.0
	Sal spp.			40.0	20.0			40.0	10.0	35.0	25.0						
B2c	Sal spp.	15.0	10.0			15.0	25.0	30.0		15.0	15.0	40.0	10.0	185.0	15.4	75	13.3
	Bet gl	5.0	60.0			25.0	12.0			5.0	5.0			112.0	9.3	90	6.6
	Pot fr			3.0					3.0	5.0		1.0	0.5	12.5	1.0	42	0.6
C	Geu ri	1.0		3.0	5.0	1.0			1.0	1.0	4.0	2.0	2.0	20.0	1.7	75	1.5
	Pot sa			0.5	1.0	1.0	0.5	4.0	2.0		2.0	1.0	0.5	12.5	1.0	75	0.9
	Rub ac	0.5		2.0			0.5	0.5	2.0	0.5	2.0	1.0	1.0	10.0	0.8	75	0.7
	Epi an		0.5	0.5	0.5	0.5			4.0		0.5	1.0		7.5	0.63	58	0.5
D	Car spp.	10.0	15.0	2.0	5.0	5.0	3.0	4.0	20.0	7.0	2.0	2.0	5.0	88.0	6.7	100	6.7
	Jun spp.				7.0	8.0	0.5				0.5	0.5		16.5	1.4	42	0.9
Ea	F Moss	86.0	30.0	19.0	47.0	15.0	82.0	89.0	9.0	48.0	93.0	59.0	58.0	811.0	50.9	100	50.9
	Sphagnum spp.						12.0					28.0	9.0	49.0	4.0	35	2.0

NOTE: Species with pl 0.5: Pin co, Pic gl, Pic na, Vac ca, Ribies spp., Val se, Ast cf, Pol pu, Ach mi, Car ar, Sol spp., Ran spp., Pot gr, Mer pa, The ve, Fra vi, Gal ba, Del gl, Ped gr, Pol vi, Equ se, Mit nu, Pot di, Rum spp., Equ spp., Bro spp., Des ca, Poo spp., Cal pu, Lichen spp.

APPENDIX K

PLOT DATA FOR COMMUNITY TYPE DWARF BIRCH-ASTER-ROUGH FESCUE (B2)

Plot No.	B1	B2	B4	108
Parent Material	GF	GF	Ft	GF
Degrees Slopes	-	-	-	-
Elevation (metres)	1210	1280	1280	1500
Aspect	-	-	-	-
Forest Cover Type				
Date	23/06	25/06	25/06	09/07

Biomass (kg/ha):

Grass

Forbs

Browse

Species	Percent Cover				Sum	c	%f	pi
B2a Bet gl	40.0	35.0	50.0	10.0	135.0	33.8	100	33.8
Sal spp.	30.0	10.0		70.0	110.0	27.5	75	23.8
Pot fr	5.0				5.0	1.3	25	0.7
B2b Bet gl		20.0	10.0	20.0	50.0	12.5	75	10.8
Sal spp.		5.0		20.0	25.0	6.3	50	4.4
Arc uv			10.0		10.0	2.5	25	1.3
Pot fr		3.0	1.0		4.0	1.0	50	0.7
C Ast ci	5.0	2.0	0.5	3.0	10.5	2.6	100	2.6
Epi an	3.0	2.0		1.0	6.0	1.5	75	1.3
Tha ve	2.0	1.0	0.5	1.0	4.5	1.1	100	1.1
Val se	1.0	1.0	0.5	2.0	4.5	1.1	100	1.1
Ach me	1.0	1.0	1.0	1.0	4.0	1.0	100	1.0
Gal bo	1.0	1.0	0.5	1.0	3.5	0.9	100	0.9
Sal spp.		0.5		3.0	3.5	0.9	50	0.6
Pot gr	0.5	1.0		1.0	2.5	0.6	75	0.5
Geu tr		1.0	2.0		3.0	0.8	50	0.5
D Ely in	6.0			0.5	6.5	1.6	50	1.1
Fes sc		1.0	3.0	1.0	5.0	1.3	75	1.1
Cor spp.	0.5	0.5	0.5	1.0	2.5	0.6	100	0.6
Bro spp.	4.0				4.0	1.0	25	0.5
Eb Moss		0.5	1.0	4.0	5.5	1.4	75	1.2
EL Lichen				4.0	4.0	1.0	25	0.5

NOTE: Species with pi 0.5: Pot di, Ped gr, Mer pa, Lat oc, Del gl, Ste lo, Cer an, Pen pr, Fra vi, Ziz ap, Vic am, Rub ac, Vio ad, Cal ru, Agr sa, Dan in, Poa spp., Des ca, Jun spp.

APPENDIX L
PLOT DATA FOR COMMUNITY TYPE DWARF BIRCH-KOBRESIA (B2)

Plot No.	30	32	35	97	98	99				
Parent Material	Mvb H	Ff	GF	GFvb H	Fo	GFvb H				
Degrees Slope	-	-	-	-	-	-				
Elevation (metres)	1900	1800	1820	1375	1460	1460				
Aspect	-	-	-	-	-	-				
Forest Cover Type										
Date	27/06	17/06	27/06	7/07	21/07	21/07				
Biomass (kg/ha):										
Grass		306		118	52					
Forbs		184		78	112					
Browse	2.7	15.7	4.9	0.7	0					
Species	Percent Cover					Sum	c	zf	pi	
B2a Bet gl	40.0	65.0	45.0	35.0		185.0	30.8	66	25.0	
Sal spp.	20.0	5.0	5.0			30.0	5.0	50	3.5	
B2b Bet gl					20.0	25.0	4.2	33	2.4	
Pot fr		2.0			5.0	12.0	2.0	50	1.4	
Arc uv		10.0		5.0		15.0	2.5	33	1.4	
Sal spp.					10.0	10.0	1.7	17	0.7	
C Ach mi	0.5	1.0	2.0	2.0		6.5	1.1	83	1.0	
And ch	0.5	0.5	1.0	0.5	2.0	4.5	0.8	83	0.7	
Ast ci	1.0	0.5				4.5	0.8	50	0.6	
Hed ma				1.0	3.0	4.5	0.8	50	0.6	
Pol vi	0.5			0.5	2.0	4.0	0.7	66	0.6	
Gal bo			1.0	1.0		4.0	0.7	50	0.5	
Ant spp.			0.5	0.5	2.0	3.5	0.6	66	0.5	
Rub ac	1.0		1.0	0.5	1.0	4.0	0.7	66	0.5	
D Kob be	5.0	10.0	11.0	39.0	8.0	90.0	15.0	100	15.0	
Ely in	1.0	4.0	2.0	3.0		16.0	2.7	83	2.5	
Dan in		10.0		3.0		13.0	2.2	33	1.3	
Eb F moss	4.0	0.5	1.0	1.0	5.0	15.5	2.6	100	2.6	

NOTE: Species with pi 0.5: Pic gl, Sen spp., Del gl, Pot di, Epi an, Cer ar, Hed sa, Vio ad, Sol spp., Pen pr, Geu tr, Tha ve, Fra vi, Ziz ap, Pol pu, Jun spp., Bro spp., Cal in, Des ca, Lichen, Pel ap

APPENDIX M
PLOT DATA FOR COMMUNITY TYPE HAIR GRASS (B2)

Plot No.	2	3b	83	93	95	96	111c	111d	113a	113b	113c	A-1
Parent Material	GF	GL	Fo	Ft	GFyb H	GFyb H	Fo	Fo	Fo	Fo	Fo	Fo
Degrees Slope	-	-	-	-	-	-	-	-	-	-	-	-
Elevation (metres)	1480	1410	1280	1250	1360	1365	1495	1495	1525	1530	1527	1950
Aspect	-	-	-	-	-	-	-	-	-	-	-	-
Forest Cover Type												
Date	05/06	06/06	25/06	25/06	07/07	07/07	22/07	22/07	26/07	26/07	26/07	08/08
Biomass (kg/ha):												
Grass	1566				552	1114			806		1212	
Forbs	406				488	992			660		838	
Browse												
Species	Percent Cover											Sum
B2B Pot fr			5.0						2.0	3.0	2.0	12.0
C Ach mi	1.0	2.0	7.0	6.0	3.0	1.0	5.0		4.0	5.0	0.5	47.5
Tha ve	5.0	1.0	9.0	2.0	7.0	11.0	9.0		5.0	5.0		54.0
Ast ci		1.0	13.0	5.0	2.0		1.0		4.0	4.0	2.0	32.0
Pot di	4.0	2.0		13.0		0.5	1.0		2.0	2.0		29.5
Geu tr	4.0		11.0		4.0	1.0	1.0		2.0	1.0		24.0
Geu ri	2.0	0.5				0.5			2.0		16.0	21.0
Sol spp.	5.0	4.0				4.0						14.0
Gal bo			1.0	0.5	2.0	0.5	2.0	1.0	2.0	3.0		15.0
Pen pr		3.0			0.5	0.5	1.0		2.2	2.0		9.5
Rur spp.	0.5	2.0				0.5				0.5	1.0	4.0
Pot gr	0.5		6.0		1.0	0.5				0.5		8.5
Tar of			4.0	1.0		4.0						9.0
D Des ca	31.0	20.0	1.0	17.0	16.0	19.0	4.0	5.0	28.0	5.0	28.0	182.0
Car spp.	5.0	3.0	0.5	37.0	7.0	14.0	1.0	7.0	2.0	6.0	5.0	102.5
Jun spp.	0.5			1.0	3.0	5.0	0.5	0.5	1.0	1.0	5.0	17.5
Ely in	0.5				6.0	3.0	0.5		2.0	8.0		21.0
Bro pa		0.5				0.5	0.5		4.0			65.0
Eb F muss	5.0	1.0					1.0					9.0

NOTE: Species with pl. 0.5: Bet gl, Pol pu, Pet sa, Ago su, Ziz sp, Val se, Ran spp., Pet pa, Cer ar, Mer pa, Rub ac, Del gl, Epi an, Vic an, Fra vi, Astr spp., Ste lo, Pol vi, Ast la, Com ra, Fes sa, Dan in, Luz pa, Kob be, Cal ru, Agr su, Fes ac, Poa spp., Agr tr, Lichen spp., Ant sp, Pol ca, Pet sa, Bro in, Lat oc

APPENDIX II

PLOT DATA FOR FORAGE TYPE DWARF BIRCH-BEARBERRY-HEDYSARUM (B3)

Plot No.	90	91	11a	H-5	H-14				
Parent Material	Ft	Ft	Fo	Ff	F				
Degrees Slope	0	0	0	0	-				
Elevation (metres)	1230	1240	1490	2030	1920				
Aspect	-	-	-	-	-				
Forest Cover Type	A1P(Sw)								
Date	25/06	25/06	22/07	08/08	08/08				
Biomass (kg/ha):									
Grass			140	90	68				
Forbs			536	510	28				
Browse	2.2	55.2	15						
Species									
	Percent Cover				Sum	$\bar{X}$	Σf	pi	
B1 Pin co	8.0		10.0		18.0	3.6	40	2.3	
Pic gl	8.0		10.0		18.0	3.6	40	2.3	
B2a Bet gl	15.0	60.0		5.0	60.0	140.0	28.0	80	25.0
Sal spp.			20.0	13.0	30.0	63.0	12.6	60	9.8
Pot fr	10.0			7.0		17.0	3.4	40	2.1
B2b Arc uv	35.0	15.0	30.0	8.0		88.0	17.6	80	15.7
Sal spp.		10.0		4.0	50.0	64.0	12.8	60	9.8
Bet gl					50.0	50.0	10.0	20	4.0
Pot fr		5.0	6.0	2.0		13.0	2.6	60	2.0
C Hed ma	1.0		1.0	23.0	1.0	26.0	5.1	80	4.6
Fra vi	3.0	5.0	7.0			15.0	3.0	60	2.3
Ach mi	1.0	2.0	1.0	0.5	0.5	5.0	1.0	100	1.0
Sal spp.	2.0	1.0		1.0	2.0	6.0	1.1	80	1.0
Geu tr		10.0				10.0	2.0	20	0.9
Oxy spp.	5.0	0.5		0.5		6.0	1.1	60	0.8
Ast ci		3.0	2.0		1.0	6.0	1.1	60	0.8
Ant spp.		5.0		1.0		6.0	1.1	40	0.7
Gal bo	0.5	2.0	1.0			3.5	0.7	60	0.5
D Car spp.	3.0	2.0	0.5	4.0	1.0	10.5	2.1	100	2.1
Ely in	6.0			1.0	0.5	7.5	1.5	60	1.2
Agr sw	1.0	4.0	0.5			5.5	1.1	60	0.8
Eb F moss		2.0	15.0	4.0		21.0	4.2	60	3.3
El Lichen spp.		1.0	14.0			15.0	3.0	40	1.9

NOTE: Species with pi 0.5: Pop tr, Dry dr, She ca, Pot gr, Pen pr, And se, And ch, Pol pu, Rub ac, Equ spp., Ane mu, Ara spp., Pol vi, Eri spp., Pet sa, Tar of, Cam ro, Pyr se, Hab spp., Cer ar, Epi an, Ran spp., Tha ve, Sen pa, Geu ri, Astr spp., Ziz ap, Vic am, Ant ni, Oxy ca, Agr da, Cal spp., Fes sa, Poa spp., Fes sc, Des ca, Bro pu, Pel spp.

APPENDIX O
PLOT DATA FOR FORAGE TYPE ALPINE (G6)

Plot No.	H-1	H-2	H-6	H-7	40	H-8	47
Parent Material	Cvb R	Cvb R	Cvb R	Cvb R	Cvb R	Cb R	Cv R
Degrees Slope	-	9	2	13	14	6	20
Elevation (metres)	2260	2200	2280	2240	2120	2220	2120
Aspect	-	SW	N	NE	S	S	S
Forest Cover Type							
Date	08/08	08/08	08/08	08/08	08/08	08/08	29/06
Biomass (kg/ha):							
Grass	0	0	4	10			
Forbs	0	0	624	144			
Browse	0	0	0	0			
Species	Percent Cover						
B2b Dry ho	30.0	10.0	40.0	75.0	20.0		2.0
Sal ni	0.5	5.0	1.0	2.0			
Arc uv		20.0					8.0
Arc ru			2.0				
Pot fr					12.0	1.0	7.0
Cas te					1.0		
Sal spp.						5.0	
C Rum spp.					0.5	1.0	
Ane pa				0.5	0.5		
Ane mu					0.5		
Myo al				0.5	0.5	0.5	
Oxy ca					5.0		3.0
Sen pa	1.0	1.0	0.5	1.0			
Sax br	0.5			0.5	0.5		2.0
Pol vi		0.5	1.0	2.0	1.0	2.0	0.5
Oxy po	0.5		1.0	4.0			
Sol spp.				2.0	0.5	1.0	2.0
Cas ni	0.5		1.0				
And ch	0.5		0.5		0.5		0.5
Sax spp.	0.5	0.5					0.5
Sed ro			0.5				
Pot di	0.5	0.5	0.5	1.0	1.0		0.5
Eri spp.		0.5			0.5	0.5	0.5
Ant spp.	0.5	0.5			0.5		0.5
Sne ca	0.5		0.5	1.0		0.5	
Ped br	0.5						
Epi an		3.0			0.5		0.5
Rhi cr		0.5				0.5	
Astr al				1.0			
Agg au		0.5				0.5	
Hed na		2.0	0.5	6.0			1.0
Zig el		0.5			1.0	1.0	1.0
Arn spp.		0.5		2.0			
Ach ni		0.5					
And se						0.5	
Sed st		0.5		0.5			0.5
Pot gr		0.5					
Dra ol			0.5		0.5	0.5	0.5
Ant ni			0.5		0.5		
Lep py	0.5		0.5		0.5	0.5	
Ast spp.			1.0			1.0	0.5
Pot ni			0.5		0.5	0.5	0.5
Ped ca			0.5	1.0			
Oxy spp.				0.5		0.5	
Hed al						5.0	
Cer ar						0.5	0.5
Gal bo						0.5	0.5
And se							
D Kob be				3.0		10.0	4.0
Fes sa	0.5		0.5	1.0		0.5	
Koe cr	1.0						
Car spp.		0.5	1.0	1.0	2.0		
Ely in		1.0	0.5	1.0	1.0	3.0	1.0
Poa spp.			0.5	0.5		1.0	0.5
Cal spp.					0.5		0.5
Eb Moss			2.0				
EL Lichen	2.0		3.0	2.0	1.0		0.5

APPENDIX P
PLOT DATA FOR FORAGE TYPE ASPEN-ROSE-HAIRY WILD RYE (A1)

Plot No.	13	70	73	75				
Parent Material	<u>Cvb</u> R	<u>Mvb</u> R	<u>Mvb</u> R	<u>Mvb</u> R				
Degrees Slope	13	29	14	18				
Elevation (metres)	1420	1230	1360	1260				
Aspect	SW	S	S	SSE				
Forest Cover Type	C2AP	C3A	C3A	C3A				
Date	06/06	23/06	23/06	23/06				
Biomass (kg/ha):								
Grass		118	486					
Forbs		98	786					
Browse		54	12.8					
Species	Percent Cover				Sum	$\bar{x}$	Σf	pi
A1 Pop tr	25.0	65.0	60.0	75.0	22.5	56.3	100	56.3
Pin co	25.0				25.0	6.3	25	3.2
A2 Pop tr	3.0	5.0	10.0		18.0	4.5	75	3.7
B1 Pop tr	3.0	3.0	30.0		36.0	9.0	75	7.8
B2a Ros ac			20.0	10.0	30.0	7.5	50	5.3
Pop tr	2.0	10.0	5.0		17.0	4.3	75	3.7
Ame al		15.0		4.0	19.0	4.8	50	3.4
Pru vi		15.0			15.0	3.8	25	1.9
Sym al				10.0	10.0	2.5	25	1.3
Rub st			5.0		5.0	1.3	25	0.7
Pop ba		5.0			5.0	1.3	2.5	0.7
Lon in				5.0	5.0	1.3	25	0.7
B2b Ros ac	10.0	5.0	10.0		35.0	8.8	75	7.7
Rub st		10.0	10.0	5.0	25.0	6.3	75	5.5
Jun co	20.0				20.0	5.0	25	2.5
Sym al		10.0	2.0		12.0	3.0	50	2.1
Ame al			5.0		5.0	1.3	25	0.7
Lon in		5.0			5.0	1.3	25	0.7
Arc uv	5.0				5.0	1.3	25	0.7
Rib spp.		4.0			4.0	1.0	25	0.5
C Epi an	2.0	1.0	6.0	13.0	22.0	5.5	100	5.5
Lat oc	6.0	1.0	2.0	5.0	14.0	3.5	100	3.5
Fra vi	4.0	2.0	2.0	5.0	13.0	3.3	100	3.3
Mer pa		0.5	4.0	8.0	12.5	3.1	75	2.7
Vic am	1.0	0.5	3.0	3.0	7.5	1.9	100	1.9
Ast co	2.0		2.0	1.0	5.0	1.3	75	1.1
Gal bo	1.0	1.0	1.0	1.0	4.0	1.0	100	1.0
Ast ci		3.0	2.0		5.0	1.3	50	0.9
Rub pu				5.0	5.0	1.3	25	0.7
D Ely in	10.0	2.0	1.0	11.0	24.0	6.0	100	6.0
Eb Feathermoss	3.0			0.5	3.5	0.9	50	0.6

NOTE: Species with pi 0.5: Pet pa, Arn co, Ach mi, Bro in, Lin bo, Tha ve, Del gl, Smi st, Pyr as, Mai ca, Vio re

APPENDIX Q
PLOT DATA FOR FORAGE TYPE CLEARCUT (D1)

Plot No.	10	18	80
Parent Material	$\frac{Cb}{R}$	$\frac{Mb}{R}$	$\frac{Mub}{R}$
Degrees Slope	22	0	2
Elevation (metres)	1700	1380	1290
Aspect	SW	-	N
Forest Cover Type	CC	CC	CC
Date	06/06	07/06	23/06

Biomass (kg/ha):

Grass	226	496	158
Forbs	19.4	74	642
Browse		32.3	73.1

Species	Percent Cover			Sum	$\bar{x}$	%f	pi	
B2a	Pin ca	5.0	25.0	30.0	10.0	67	8.2	
	Pop tr		15.0	15.0	5.0	33	2.9	
	Sal spp.	5.0	5.0	10.0	3.3	67	2.7	
	Vib ed		10.0	10.0	3.3	33	1.9	
	She ce		5.0	5.0	1.7	33	1.0	
B2b	Lin bo	3.0	20.0	23.0	7.7	67	6.3	
	Vac ca	3.0	10.0	16.0	5.3	100	5.3	
	Ros ac	3.0	7.0	10.0	3.3	67	2.7	
	Pin co	5.0	3.0	8.0	2.7	67	2.2	
	Rub st	5.0	2.0	7.0	2.1	67	1.7	
	Spi lu		7.0	7.0	2.3	33	1.3	
	Sal spp.		5.0	5.0	1.7	33	1.0	
	Vac vi		5.0	5.0	1.7	33	1.0	
C	Cor ca	2.0	1.0	15.0	18.0	6.0	100	6.0
	Epi an	2.0	4.0	10.0	16.0	5.3	100	5.3
	Ast ci		3.0	2.0	5.0	1.7	67	1.4
	Mai ca		1.0	2.0	3.0	1.0	67	0.8
	Arn co	2.0	0.5		2.5	0.8	67	0.7
	Rub pu		4.0	4.0	1.3	33	0.7	
D	Cal ru	1.0	4.0	5.0	10.0	3.3	100	3.3
	Ely in	6.0	5.0		11.0	3.7	67	3.0
	Agr spp.		4.0	4.0	1.3	33	0.7	
Eb	Feathermoss	3.0	16.0	6.0	25.0	8.3	100	8.3

NOTE: Species with pi 0.5: Aln cr, Pic gl, Pyr as, Fra vi, Car spp., Pel spp.

APPENDIX R

PLOT DATA FOR FORAGE TYPE WILLOW-ASTER (B₄)

Plot No.	H-9	H-13				
Parent Material	$\frac{Cv}{R}$	$\frac{Cv}{R}$				
Degrees Slope	-	15				
Elevation (metres)	2120	2120				
Aspect	N	N				
Forest cover type						
Date	08/08	09/08				
Biomass (kg/ha):						
Grass	2	4				
Forbs	226	170				
Browse						
Species	Percent Cover		Sum	c	%f	pi
B1 Pic en	1.0	0.5	1.5	0.8	100	0.8
B2a Sal spp.	15.0	80.0	95.0	47.5	100	47.5
Bet gl	5.0		5.0	2.5	50	1.8
Abi la		2.0	2.0	1.0	50	0.7
Pic en	1.0	1.0	1.0	0.5	100	0.5
B2b Sal spp.	15.0	15.0	30.0	15.0	100	15.0
Bel gl	5.0		5.0	2.5	50	1.8
Sal ni	5.0	1.0	6.0	3.0	100	3.0
Phy gl		2.0	2.0	1.0	50	0.7
C Ast ci	3.0	6.0	9.0	4.5	100	4.5
Sen pa	3.0	5.0	8.0	4.0	100	4.0
Ant la	4.0	2.0	6.0	3.0	100	3.0
Sib pr	5.0	1.0	6.0	3.0	100	3.0
Tro al		7.0	7.0	3.5	50	2.5
Pot di	5.0	0.5	5.5	2.3	100	2.3
Epi an	1.0	3.0	4.0	2.0	100	2.0
Eri spp.	4.0		4.0	2.0	50	1.4
Ver al	1.0	0.5	1.5	0.8	100	0.8
Pol vi	0.5	1.0	1.5	0.8	100	0.8
Ped ca	0.5	1.0	1.5	0.8	100	0.8
Ach mi	2.0		2.0	1.0	50	0.7
Equ sc	0.5	0.5	1.0	0.5	100	0.5
Eb F moss	40.0	1.0	41.0	20.5	100	20.5
E1 Pel ap	10.0	0.5	10.5	5.3	100	5.3

NOTE: Species with pi 0.5: Luz pa, Sol spp., Ran spp., Cer ar, Pen pr, Cas mi, Dra ol, Phl al, Koe cr, Fes spp., Car spp., Lichen

APPENDIX 5
PLOT DATA FOR FORAGE TYPES B5
(DATA FROM ROCKY-NORTH SASKATCHEWAN STUDY AREA)

Plot No.	11	99	107	109	111	112	199	256	102					
Parent Material	Mb Rui	Mb Rui	Mv RTr	Mv RTr	Mv RTr	Mv RTr	Mb Ru	Mv RT	Mb Rui					
Degrees Slope	4.5	2	-	9	8	8	12	5	14					
Elevation (metre)	1050	1580	1280	1280	1300	1340	1345	1490	1500					
Aspect	NNE	SE	NE	N	WNW	WNW	NNE	E	W					
Biomass (kg/ha):														
Grass			147.4	631.6	625.5		826.0		292.8					
Forbs			352.0	905.0	1032.4				332.8					
Browse			1.7	1.9	42.8									
Species														
Percent Cover										Sum	X	zf	pi	
A1	Pic gl Pin co Pop tr	0.5 0.5 15.0	0.5 3.0		3.0 15.0 15.0		3.0 15.0 3.0	15.0	15.0	37.0 33.0 33.0	4.1 3.7 3.7	67 44 33	3.4 2.5 2.1	
A2	Sal spp. Pic gl Pop tr	15.0				38.0 15.0 15.0	3.0			53.0 18.0 15.0	5.9 2.0 1.7	22 22 11	2.8 0.9 0.6	
B1	Aln cr Pop tr Pic gl Sal spp.		15.0	15.0 0.5	3.0 3.0 0.5	15.0 0.5 0.5	62.0 3.0 3.0 15.0		15.0	3.0	80.0 36.5 22.5 18.0	8.9 4.1 2.5 2.0	33 56 67 22	5.1 3.1 2.0 0.9
B2	Aln cr Vib ed Pop tr Ros ac Lon in Abi la Lin bo Rub st Rib spp. Bet pa Sal spp. Pop ba Vac my Pic gl		0.5	3.0 3.0	38.0 15.0	15.0 38.0	15.0 38.0	38.0			109.5 94.0 92.5 69.0 59.0 41.5 27.0 24.0 18.0 38.0 12.0 15.5 15.0 7.0	12.2 10.4 10.3 7.7 6.6 4.6 3.0 2.7 2.0 4.2 1.3 1.7 1.7 0.8	67 44 44 78 44 33 56 44 67 11 44 22 11 44 0.5 0.5	10.0 6.9 6.8 6.8 4.4 2.6 2.2 1.8 1.6 1.4 0.9 0.8 0.6 0.5
C	Epi an Cor ca Mer pa Her la Ara nu Arn co Rub pu Pet pa Ast spp. Equ spp. Mit nu	10.0 5.0 4.0 5.0 2.0 3.0 2.0 0.5	5.0 4.0 0.5 0.5 0.5 2.0 2.0 0.5 5.0 0.5	6.0 1.0 3.0 1.0 0.5 2.0 2.0 1.0 0.5 2.0 0.5	5.0 3.0 5.0 5.0 0.5 1.0 3.0 3.0 3.0 4.0 0.5	19.0 3.0 4.0 8.0 7.0 3.0 1.0 1.0 3.0 1.0 3.0	4.0 4.0 0.5 25.0 7.0 3.0 1.0 0.5 0.5 3.0	4.0 4.0 1.0 25.0 1.0 2.0 0.5 3.0 0.5 0.5	6.0 4.0 2.0 1.0 2.0 0.5 2.0 0.5 0.5 3.0	5.0 6.0 2.0 1.0 21.0 15.5 11.5 11.0 10.5 8.5 8.0	7.1 3.0 2.4 3.6 2.3 1.7 1.3 1.2 1.2 0.9 0.9	100 78 100 44 56 78 67 56 44 67 67	7.1 2.6 2.4 2.4 1.7 1.5 1.1 0.9 0.8 0.7 0.7	
D	Ely in Cal spp.		16.0 2.0	13.0 11.0	8.0 9.0	7.0 7.0		13.0 18.0	8.0 0.5	69.0 50.5	7.7 5.6	78 78	6.8 4.9	
Eb	Moss	3.0			1.0			8.0	42.0	62.0	6.9	67	5.6	

NOTE: Species with pi 0.5: Ame al, Sor sc, Spi lu, Vic am, Lat oc, Fra vi, Osm de, Ast co, Pyr as, Mai ca, Gal tr, Ach mi, Gal bo, Tar of, Geu tr, Tri spp., Cer ar, Str am, Gym dr, Vio spp., Utr spp., Ger spp., Tha ve, Pyr se, Luz nu, Car spp., Bro spp., Phi pr, Pel spp., Lichens

Plot No.	77	79	92	95	128	151	186	188	214	215	225				
Parent Material	Oo	Oo	Ov MT	Ov MT	Ov GL1	Mb RT	Ov MT	Oh	Oh	Oh	Oh				
Degrees Slope	2	2	-	-	-	-	-	-	-	-	-				
Elevation (metres)	1390	1315	1290	1345	1240	1130	1280	1200	1160	1145	1310				
Aspect	SSw	MNW	-	-	-	-	0	-	-	-	-				
Biomass (kg/ha):															
Grass	340.4	571.5				318.8									
Forbs	117.2	173.6				146.8									
Browse	4.1	4.8				0.2									
Species												Percent Cover			
												Sum	$\bar{X}$	tf	pi
A1	Pic ma Lar la	0.5 0.5	0.5 15.0	3.0 15.0	15.0				3.0	3.0 3.0	0.5	40.5 33.5	3.7 3.0	73 36	3.2 1.8
A2	Pic ma		0.5		15.0							16.0	1.5	27	0.8
B1	Pic ma Lar la	0.5 0.5	0.5 0.5	3.0 15.0	15.0	15.0	38.0 3.0		38.0 3.0	3.0	0.5	110.5 40.0	10.0 3.6	73 64	8.5 2.9
B2	Bet gl Sal spp. Lar la Pic ma Led gr Lin bo Arc uv Vac vi	62.0 15.0 62.0 3.0	62.0 3.0 38.0 3.0	62.0 15.0 15.0 3.0	62.0 15.0 15.0 15.0	38.0 15.0 15.0 15.0	15.0 3.0 38.0 3.0	15.0 15.0 3.0 15.0	38.0 38.0 3.0 15.0	3.0 3.0 3.0 15.0	62.0 3.0 15.0 0.5	457.0 125.0 148.0 77.5 63.5 18.0 15.5 13.5	41.5 11.4 13.5 7.0 5.8 1.6 1.4 1.2	100 91 55 64 55 18 18 27	41.5 10.9 10.0 5.6 4.3 0.7 0.6 0.6
C	Smi tr Men tr	17.0 4.0 5.0	4.0 0.5	0.5 11.0	13.0	7.0		6.0 3.0	2.0 5.0	12.0	5.0	55.0 36.5	5.0 3.3	82 55	4.5 2.4
D	Car spp. Jun spp.	48.0 30.0	62.0 19.0	12.0 40.0	9.0 0.5	20.0	5.0 0.5	34.0 0.5	13.0 5.0	9.0 5.0	17.0 6.0	235.0 95.0	21.4 8.6	100 55	21.4 6.4
Eb	Moss	73.0	43.0	24.0	38.0	95.0	78.0	73.0	41.0	71.0	33.0	657.0	59.7	100	59.7

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APPENDIX U
SPECIES LIST BY VEGETATION LAYER

Layer A

<u>Common Name</u>	<u>Latin Name</u>	<u>Abbreviation</u>
* Alpine Fir	<i>Abies lasiocarpa</i>	Abi la
Balsam Poplar	<i>Populus balsamifera</i>	Pop ba
Black Spruce	<i>Picea mariana</i>	Pic ma
Engelmann Spruce	<i>Picea engelmannii</i>	Pic en
Lodgepole Pine	<i>Pinus contorta</i>	Pin co
Tamarack	<i>Larix laricina</i>	Lar la
* Trembling Aspen	<i>Populus tremuloides</i>	Pop tr
White Spruce	<i>Picea glauca</i>	Pic gl

Layer B

Blueberry	<i>Vaccinium myrtilloides</i>	Vac my
Bog Cranberry	<i>Vaccinium vitis-idaea</i>	Vac vi
Bracted Honeysuckle	<i>Lonicera involucrata</i>	Lon in
Bristly Black Currant	<i>Ribes lacustre</i>	Rib la
Canadian Buffalo-berry	<i>Shepherdia canadensis</i>	She ca
Common Bearberry	<i>Arctostaphylos uva-ursi</i>	Arc uv
Creeping Juniper	<i>Juniperus horizontalis</i>	Jun ho
Currant	<i>Ribes species</i>	Rib spp.
Dwarf Bilberry	<i>Vaccinium caespitosum</i>	Vac ca
* Dwarf Birch	<i>Betula glandulosa</i>	Bet gl
Green Alder	<i>Alnus crispa</i>	Aln cr
Ground Juniper	<i>Juniperus communis</i>	Jun co
Grouse-berry	<i>Vaccinium scoparium</i>	Vac sc
Labrador Tea	<i>Ledum groenlandicum</i>	Led gr
Limber Pine	<i>Pinus flexilis</i>	Pin fl
* Low-bush Cranberry	<i>Viburnum edule</i>	Vib ed
Menziesia	<i>Menziesia glabella</i>	Men gl
Mountain Ash	<i>Sorbus scopulina</i>	Sor sc
Mountain Laurel	<i>Kalmia polifolia</i>	Kal po
* Prickly Rose	<i>Rosa acicularis</i>	Ros ac
* Saskatoon-berry	<i>Amelanchier alnifolia</i>	Ame al
Shrubby Cinquefoil	<i>Potentilla fruticosa</i>	Pot fr
Snowberry	<i>Symphoricarpos albus</i>	Sym al

NOTE: Species marked with an *are considered to be palatable browse species

Layer B

<u>Common Name</u>	<u>Latin Name</u>	<u>Abbreviation</u>
Tall Bilberry	<i>Vaccinium membranaceum</i>	Vac me
Twinflower	<i>Linnaea borealis</i>	Lin bo
Twining Honeysuckle	<i>Lonicera dioica</i>	Lon di
White Dryad	<i>Dryas hookeriana</i>	Dry ho
White-flowered Rhododendron	<i>Rhododendron albiflorum</i>	Rho al
White Meadowsweet	<i>Spiraea lucida</i>	Spi lu
White Mountain Heather	<i>Cassiope tetragona</i>	Cas te
Wild Black Currant	<i>Ribes americanum</i>	Rib am
Wild Red Currant	<i>Ribes triste</i>	Rib tr
*Willow	<i>Salix species</i>	Sal spp.
Willow	<i>Salix nivalis</i>	Sal ni
Yellow Dryad	<i>Dryas drummondii</i>	Dry dr
Yellow Heather	<i>Phyllodoce glanduliflora</i>	Phy gl

Layer C

Anemone	<i>Anemone parviflora</i>	Ane pa
Arnica	<i>Arnica alpina</i>	Arn al
Arnica	<i>Arnica cordifolia</i>	Arn co
Bastard Toad-flax	<i>Comandra pallida</i>	Com pa
Bastard Toad-flax	<i>Geocaulon lividum</i>	Geo li
Beard-tongue	<i>Penstemon species</i>	Pen spp.
Bishop's cap	<i>Mitella nuda</i>	Mit nu
Bistort	<i>Polygonum viviparum</i>	Pl vi
Bluebell	<i>Campanula rotundifolia</i>	Cam ro
Blue Columbine	<i>Aquilegia brevistyla</i>	Aqu br
Blue-eyed Grass	<i>Sisyrinchium montanum</i>	Sis mo
Blunt-leaved Orchid	<i>Habenaria obtusata</i>	Hab ob
Bog Orchid	<i>Habenaria species</i>	Hab spp.
Bronze-bells	<i>Stenanthium occidentale</i>	Ste oc
Bunchberry	<i>Cornus canadensis</i>	Cor ca
Buttercup	<i>Ranunculus species</i>	Ran spp.
Cinquefoil	<i>Potentilla diversifolia</i>	Pot di
Cinquefoil	<i>Potentilla nivea</i>	Pot ni
Cinquefoil	<i>Potentilla species</i>	Pot spp.
Cloudberry	<i>Rubus chamemorus</i>	Rub ch
Common Dandelion	<i>Taraxacum officinale</i>	Tar of
Common Horsetail	<i>Equisetum arvense</i>	Equ ar
Common Pink Wintergreen	<i>Pyrola asarifolia</i>	Pyr as
Common Red Paintbrush	<i>Castilleja miniata</i>	Cas mi
Common Yarrow	<i>Achillea millefolium</i>	Ach mi

Layer C

<u>Common Name</u>	<u>Latin Name</u>	<u>Abbreviation</u>
Cow Parsnip	<i>Heracleum lanatum</i>	Her la
Cut-leaved Anemone	<i>Anemone multifida</i>	Ane mu
Dewberry	<i>Rubus pubescens</i>	Rub pu
Dock	<i>Rumex species</i>	Rum spp.
Dwarf Raspberry	<i>Rubus acaulis</i>	Rub ac
Early Blue Violet	<i>Viola adunca</i>	Vio ad
Fairy Candelabra	<i>Androsace septentrionalis</i>	And se
False Dandelion	<i>Agoseris glauca</i>	Ago gl
False Dandelion	<i>Agoseris aurantiaca</i>	Ago au
False Solomon's-seal	<i>Smilacina racemosa</i>	Smi ra
Felwort	<i>Gentianella amarella</i>	Gen am
Fireweed	<i>Epilobium angustifolium</i>	Epi an
Fleabane	<i>Erigeron species</i>	Eri spp.
Fleabane	<i>Erigeron compositus</i>	Eri co
Forget-me-not	<i>Myosotis alpestris</i>	Myo al
Gaillardia	<i>Gaillardia aristata</i>	Gai ar
Gentian	<i>Gentiana prostrata</i>	Gen pr
Gentian	<i>Gentiana species</i>	Gen spp.
Geranium	<i>Geranium richardsonii</i>	Ger ri
Goldenrod	<i>Solidago species</i>	Sol spp.
Goldthread	<i>Coptis triflora</i>	Cop tr
Graceful Cinquefoil	<i>Potentilla gracilis</i>	Pot gr
Grass-of-Parnassus	<i>Parnassia palustris</i>	Par pa
Grass-of-Parnassus	<i>Parnassia fimbriata</i>	Par fi
Greenish-flowered Wintergreen	<i>Pyrola virens</i>	Pyr vi
Ground Cedar	<i>Lycopodium complanatum</i>	Lyc co
Ground Pine	<i>Lycopodium obscurum</i>	Lyc ob
Groundsel	<i>Senecio pauciflorus</i>	Gen pa
Groundsel	<i>Senecio triangularis</i>	Gen tr
Heart-leaved Twayblade	<i>Listera cordata</i>	Lis co
Hedysarum	<i>Hedysarum alpinum</i>	Hed al
Hedysarum	<i>Hedysarum mackenzii</i>	Hed ma
Hedysarum	<i>Hedysarum sulphurescens</i>	Hed su
Horsetail	<i>Equisetum scirpoides</i>	Equ sc
Indian Pipe	<i>Monotropa uniflora</i>	Mon un
Jacob's-ladder	<i>Polemonium pulcherrimum</i>	Pol pu
Late Yellow Loco-weed	<i>Oxytropis campestris</i>	Oxy ca
Lindley's Aster	<i>Aster ciliolatus</i>	Ast ci
Loco-weed	<i>Oxytropis podocarpa</i>	Oxy po
Loco-weed	<i>Oxytropis species</i>	Oxy spp.
Lousewort	<i>Pedicularis bracteosa</i>	Ped br
Lousewort	<i>Pedicularis capitata</i>	Ped ca
Marsh Cinquefoil	<i>Potentilla palustris</i>	Pot pa
Milk Vetch	<i>Astragalus alpinus</i>	Asr al

Layer C

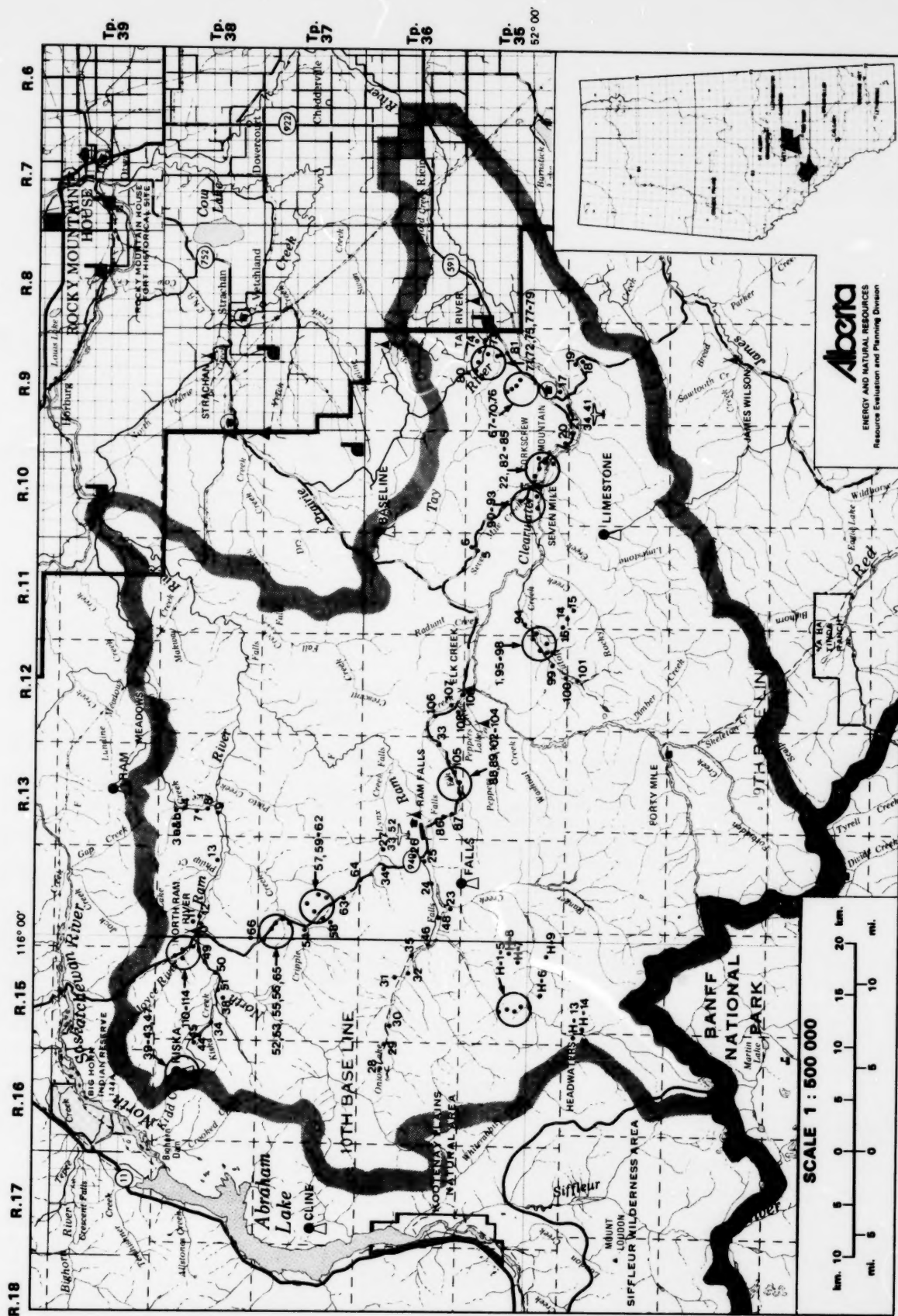
<u>Common Name</u>	<u>Latin Name</u>	<u>Abbreviation</u>
Milk Vetch	<i>Astragalus striatus</i>	Asr st
Mouse-ear Chickweed	<i>Cerastium arvense</i>	Cer ar
Nodding Onion	<i>Allium cernuum</i>	All ce
Northern Bedstraw	<i>Galium boreale</i>	Gal bo
Old Man's Whiskers	<i>Geum triflorum</i>	Geu tr
One-sided Wintregreen	<i>Pyrola secunda</i>	Pyr se
Pale Coral-root	<i>Corallorhiza trifida</i>	Cor tr
Palmate-leaved Coltsfoot	<i>Petasites palmatus</i>	Pet pa
Pea Vine	<i>Lathyrus ochroleucus</i>	Lat oc
Prairie Groundsel	<i>Senecio canus</i>	Sen ca
Purple Avens	<i>Geum rivale</i>	Geu ri
Pussy-toes	<i>Antennaria nitida</i>	Ant ni
Raspberry	<i>Rubus pedatus</i>	Rub pe
Sagebrush	<i>Artemisia michauxiana</i>	Art mi
Saxifrage	<i>Saxifraga tricuspidata</i>	Sax tr
Showy Aster	<i>Aster conspicuus</i>	Ast co
Sibbaldia	<i>Sibbaldia procumbens</i>	Sib pr
Slender Blue Beard*tongue	<i>Penstemon procerus</i>	Pen pr
Small Bog Cranberry	<i>Oxycoccus microcarpus</i>	Oxy mi
Smelowskia	<i>Smelowskia calycina</i>	Sme ca
Smooth Aster	<i>Aster laevis</i>	Ast la
Speedwell	<i>Veronica alpina</i>	Ver al
Star-flowered Solomon's seal	<i>Smilacina stellata</i>	Smi st
Stiff Club-moss	<i>Lycopodium annotinum</i>	Lyc an
Sweet-flowered Androsace	<i>Androsace chamaejasme</i>	And ch
Tall larkspur	<i>Delphinium glaucum</i>	Del gl
Three-leaved Solomon's-seal	<i>Smilacina trifolia</i>	Smi tr
Twisted-stalk	<i>Streptopus amplexifolius</i>	Str am
Valeriana	<i>Valeriana septentrionalis</i>	Val se
Veiny Meadow rue	<i>Thalictrum venulosum</i>	Tha ve
Venus'-slipper	<i>Calypso bulbosa</i>	Cal bu
Violet	<i>Viola renifolia</i>	Vio re
Western Wood Lily	<i>Lilium philadelphicum</i>	Lil ph
White Camas	<i>Zygadenus elegans</i>	Zyg el
Wild Lily-of-the-Valley	<i>Maianthemum canadense</i>	Mai ca
Wild Strawberry	<i>Fragaria virginiana</i>	Fra vi
Wild Vetch	<i>Vicia americana</i>	Vic am
Wood Anemone	<i>Anemone quinquefolia</i>	Lik ph
Yellow Rattle	<i>Rhinanthus crista-galli</i>	Rhi cr

Layer D

Awnless Brome	<i>Bromus inermis</i>	Bro in
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Layer D

<u>Common Name</u>	<u>Latin Name</u>	<u>Abbreviation</u>
Bearded Wheat Grass	<i>Agropyron subsecundum</i>	Agr su
Bluegrass	<i>Poa species</i>	Poa spp.
Brome Grass	<i>Bromus species</i>	Bro spp.
Fescue	<i>Festuca brachyphylla</i>	Fes br
Fescue	<i>Festuca saximontana</i>	Fes sa
Fescue	<i>Festuca species</i>	Fes spp.
Hairy Wild Rye	<i>Elymus innovatus</i>	Ely in
June Grass	<i>Koeleria cristata</i>	Koe cr
Kobresia	<i>Kobresia bellardii</i>	Kob be
Marsh Reed Grass	<i>Calamagrostis canadensis</i>	Cal ca
Northern Awnless Brome	<i>Bromus pumpellianus</i>	Bro pu
Northern Wheat Grass	<i>Agropyron dasystachym</i>	Agr da
Pine Grass	<i>Calamagrostis rubescens</i>	Cal ru
Purple Reed Grass	<i>Calamagrostis purpurascens</i>	Cal pu
Reed Grass	<i>Calamagrostis neglecta</i>	Cal ne
Rice Grass	<i>Oryzopsis pungens</i>	Ory pu
Rice Grass	<i>Oryzopsis species</i>	Ory spp.
Rush	<i>Juncus species</i>	Jun spp.
Sedge	<i>Carex species</i>	Car spp.
Tufted Hair Grass	<i>Deschampsia caespitosa</i>	Des ca
Wood Rush	<i>Luzula parviflora</i>	Luz pa



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